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RAILWAY BRIDGE, NEAR YORK, ENGLAND.

We publish herewith a view of a fine railway swing bridge, erected over the river Ouse, near York, England, by the North Eastern Railway. We are indebted to *Engineering* for the illustration of the structure, which consists of three openings, namely, one fixed span of 107 feet over all, and a double swing span of 176 feet over all, leaving a clear opening for vessels of about 62 feet, the river being navigable for small craft some distance above the bridge.

The swing portion of the bridge is supported on a pier of cast iron situated on the north bank of the river, this pier being composed of one central column 7 feet in diameter, containing a hydraulic accumulator, and eight supporting columns each 4 feet in diameter carrying the roller frame and path. The weight of cast iron in the pier, exclusive of the foundation cylinders, is about 280 tuns.

The swing portion is formed of two main girders, 176 feet in length and 14 feet in depth between flanges over the swivel pier, where they are connected together at the top by cross girders, carrying a platform, from which is regulated the working of the bridge. The flooring is composed of 23 transoms, 26 feet long and 1 foot 8 inches in depth, which, over the pier, are covered by $\frac{3}{8}$ inch plating, the rest of the floor being formed of bars 8 inches by $\frac{5}{16}$ inch, with openings of 1 inch.

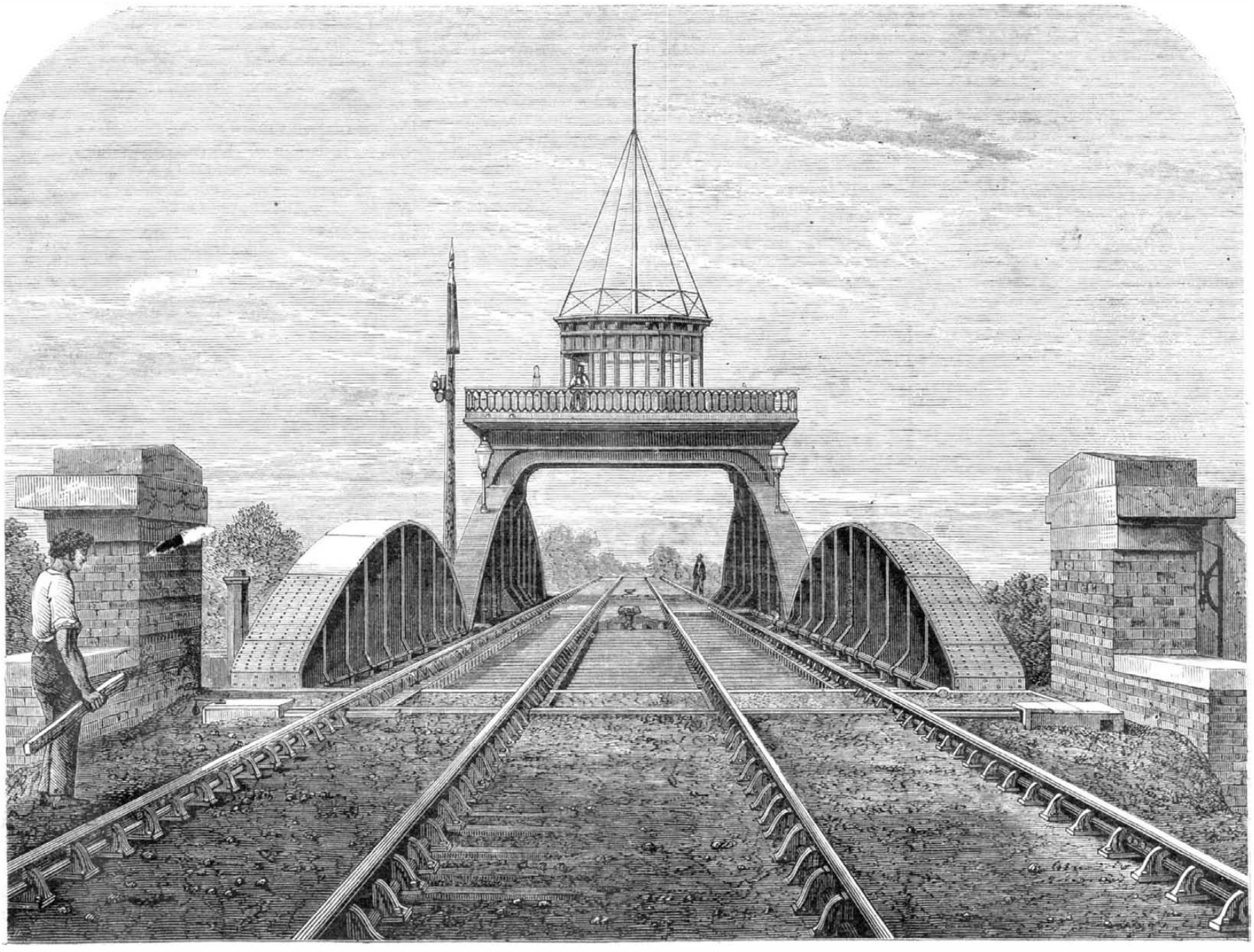
The girders and flooring of the fixed span are of the same form as those of the swing portion. The total weight of wrought iron in both swing and fixed spans collectively is 401 tuns.

The swing portion is moved by means of hydraulic machinery giving motion to a pinion geared into a circular rack.

The superstructure of the bridge was designed by Mr. J. E. Harrison, and erected by Messrs. Pease, Hutchinson & Co., of Darlington, the hydraulic machinery being devised and applied by Sir William Armstrong & Co., of Newcastle on Tyne

California's Growing Industries.

A correspondent of the New York *Times*, writing from California, states that the mining interests continue prosperous, and most of the leading mines are doing well, taking out a good quality of ore, and paying dividends. Many of the lesser ones, however, continue to levy assessments (Irish dividends); but that must necessarily be the case where no working capital is set aside for the purpose of carrying on the work of development. "It takes a mind to work a mine" is amply illustrated; but it is the history of nearly all the present dividend-paying mines. They all had to travel the old beaten tract, and occasionally relapse into their former condition. It is expecting a good deal of a mine to continue paying for an endless period of time, when we consider the fearful drain upon it to produce daily from 100 to 500 tuns of ore. It cannot be expected, you know. Take the Crown Point and Belcher, for instance. These two mines have produced, on an average, five hundred tuns daily for several years. A tun of ore is six cubic feet, and a hundred tuns makes a big hole. They have taken out forty-six millions of dollars in the last four years, and are now down in the bowels of the earth some sixteen hundred feet. If anything were wanted to prove the theory that the center of the earth is a mass of seething molten matter, the intense heat in the lower levels of some of our deep mines would be conclusive evidence. In the lower galleries of the Ophir, for instance, before the recent air shafts were completed, the heat was so intense that the shifts of men had to be changed every two hours. (When I say "shifts," I speak in mining parlance.) Occasionally they got a gush of hot water that made things lively for them. After all the fuss about the great value of our agricultural products being superior to the mining interests, the grain production has only exceeded that of mining some four millions. In the earlier days we never dreamed that California would prove an agricultural country, and we relied only upon mining; but the two interests together are pretty good. It would be difficult to name a country, with the same population, producing its equal in value—ninety-six millions in four years, that we have a record of, to say nothing of the large aggregate of the Chinese product, and that of individuals, of which we have no record, at least four millions more—say one hundred millions in total, or an average of two millions a month, and constantly increasing. California is not such a bad country after all. Wait about five years, and you will see its product doubled. Another evidence of our prosperity is the constantly increasing manufactures. We shall soon be able to supply nearly everything we require, thereby retaining in the country the money that we have heretofore sent abroad. Conspicuous among the recent enterprises, I can mention the establishing of jute bag factories, more woolen mills, and a watch manufactory. The Cornell Watch Company, of Chicago, has been transferred to this place, and will soon be in operation—the advantages being an even temperature and Chinese labor. The Chinese are probably the most intelligent and skillful people for any such purpose that can be found; quick to learn, always reliable in their work, doing a thing always alike, never striking for higher wages, never going on a spree, quiet and tractable; and they are particularly skillful where nice manipulation is required. The Watch Company will employ about 150 men, and the advantages of cheap labor will be manifest over Eastern labor in these particulars, to say nothing of the difference in price. The company were paying on an average $3.25 per day, while they will be able to obtain better operatives here at $1.25—a saving of $2 per day, less the difference between gold and currency—not much, either, when we take into consideration that their receipts will be in coin. The company will find a large outlet for their cheap watches in China and Japan, the natives of those countries being much addicted to purchasing timepieces. Every Chinaman purchases a watch. They want to know about what time they may expect to be pelted with brickbats and mud balls by the enterprising young Americans, who are inculcated at an early age in this entertaining sport.



RAILWAY BRIDGE NEAR YORK, ENGLAND

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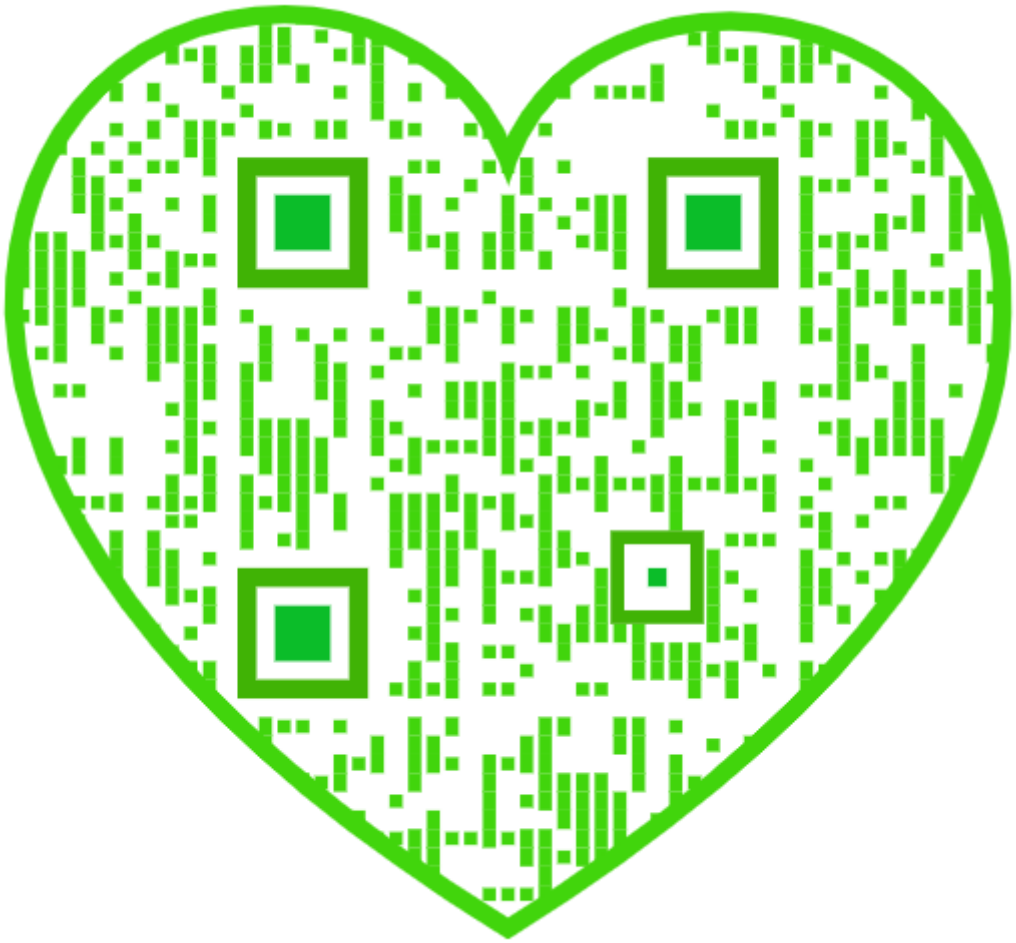

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Contents.

(Illustrated articles are marked with an asterisk.)

Bearings, alarm for hot*..... 403
Bridge, railway, near York, Eng.* 399
Bread, gases from (27)..... 409
Business and personal..... 409
Cadmium yellow..... 409
California's growing industries.... 399
Casting, blow holes in (5)..... 409
Cement for iron vessels (11)..... 409
Centennial, Great Britain and the. 404
Compound mechanical tool*..... 406
Copper by precipitation (20)..... 409
Drains and chimneys..... 401
Earth's crust, the..... 409
Electro-deposition of metals*..... 407
Etching on glass (13)..... 409
Freights, cheap..... 401
Friction pulleys (18)..... 409
Funeral, will do it after a..... 401
German silver (24)..... 409
Governors, pendulum*..... 404
Gulf stream, the (21)..... 409
Ignorance and crime..... 406
Immersion lenses (8)..... 409
Lake, the highest..... 406
Madder, rose (19)..... 409
Mammoth cave discoveries..... 406
Manganese, sesquioxide of (29).... 410
Molds for casting resin, etc.(10)... 409
Nail, a new*..... 403
Nickel, muriatic salts of (30)..... 410
Oil, oxygenized.....(26) 409
Painting on albumen paper (2)..... 409
Painting weatherboarding (12)..... 409
Patent decisions, recent..... 408
Patent law, needed amendment to 400
Patent Office clerks, the..... 401
Patent Office tea set..... 404
Patents, American and foreign.... 408
Patents, official list of..... 410
Photographs, immense..... 402
Photo skylights, etc., French*.... 403
Pickets in a fence (7)..... 409
Planing and molding machine*.... 406
Polar expedition, the latest..... 401
Power for turning wheels (14)..... 409
Power of a water wheel (9)..... 409
Practical mechanism.—No. 14*.... 405
Pressure of water in casks (1)*.... 409
Pressure on piston (4)..... 409
Pump difficulty, a (28)..... 409
Raisins, making (17)..... 409
Scientific American, subscribers.. 405
Ship, capsizing a (16)..... 409
Shipping of the world..... 403
Sun, constitution of the..... 404
Telegraph, conception of the*..... 403
Telegraphs, government monopoly 400
Telegraphy, cheap..... 406
Telescopes, reflector (6)..... 409
Thermometer, mean of a (25).. 409
Thrashing machines, iron-framed* 407
Trades unions, decline of..... 406
Underground railway, N.Y.—No. 6* 402
Venus, the transit of..... 400
Water power, sewing machines (15) 409
Waterproof paper (23)..... 409
Water troughs, size of (3)..... 409

THE LARGEST YET.

We print this week two editions of the SCIENTIFIC AMERICAN, the combined issue of which reaches the large number of One Hundred and Ninety Thousand copies. The quantity of paper required for the two editions is Five Hundred and Thirty Reams, and the weight, Thirty-Nine Thousand Seven Hundred and Fifty Pounds---little less than Twenty Tuns. We believe this to be the largest circulation of any paper of its class ever issued in a single week.

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With this issue, the time for which a large number of our subscribers have prepaid, expires. In order that our readers may experience no stoppage in the receipt of the journal, and that we may not miscalculate the quantity of the paper to print at the commencement of a new volume, we hope our friends will signify their intention to continue the paper by early remittances.

The plan of discontinuing the paper when the time expires for which it is prepaid, we think preferable to the course, adopted by many publishers, of continuing their paper indefinitely and collecting afterwards. The latter course is too much like having a bill presented for a suit of clothes after it is worn out. We shall be gratified to have every old subscriber renew, and doubly grateful if each will send one or more new names with his own.

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ANOTHER NEEDED AMENDMENT OF THE PATENT LAW.

By the present law, the grantee of any interest in a patent has ninety days within which to file his conveyance for record. If he complies with that rule, his rights are determined by the date of his deed. This furnishes abundant and unnecessary opportunity for fraud, and often imposes great hardships on innocent and careful purchasers.

He who after full examination finds the title of a patent complete and unencumbered often feels safe in paying his money therefor, and in making extensive arrangements for engaging in the manufacture thereof. Ninety days thereafter he may learn that an assignment one day older than his has just been filed in the Office, and has rendered his title worthless. This ought not so to be.

In some of the States of the Union, the registry laws relative to the conveyance of real estate have had a like provision, but experience has shown the inexpediency of such a rule. Priority of right is now generally given to the purchaser who first files his deed for record. This is a wise regulation; for if some one must suffer wrong, good policy as well as justice dictates that it should be the negligent rather than the vigilant. Is not this an equally sound maxim as applied to the sale of a patent?

At all events, the ninety days now allowed to the purchaser of a patent is much too great. No great mischief would result from allowing such a purchaser hardly time enough to send his deed to the Patent Office. If he failed to do this, his rights should be postponed to those of any other *bona fide* purchaser whose deed was first on record. A rule of vigilance similar to that which is observed in order to charge the indorser of a protested promissory note might best protect the just rights of both purchasers, and would furnish little room for injury of the kind above referred to.

But there is a still more crying evil of a similar character. A license under our present law need not be recorded at all. A *bona fide* purchaser, who has waited ninety days before paying the purchase money or doing any other irrevocable act, may afterwards find, to his dismay, that there are licenses in existence, running the entire lifetime of his patent and covering the whole scope of his conveyance, which is thus rendered wholly valueless. Opportunities for successful wrong are here presented, for which there is no excuse. They are unworthy of the intelligence of the age and country. The hand of reform should be applied here without delay.

GOVERNMENT MONOPOLY OF THE TELEGRAPH LINES.

The argument of Mr. G. P. Lowery, before the Congressional Committee, in opposition to the Hubbard Postal Telegraph bill, contains much forcible reasoning. Whether or not Congress has the right to make telegraphic intercommunication a government monopoly is clearly a constitutional question, based upon the interpretation of the sections which confer upon the national legislature the power to establish post offices and post roads, and to regulate commerce. The advocates of the scheme hold that, under these provisions, Congress has the necessary power, and urge that the telegraph must be regarded in similar light as the mails; if the government has the right to monopolize the dissemination of information through the carriage of missives in the latter case, it has the same right through the transmission of signals in the former. The opponents of the bill, including all the present private telegraphic corporations, deny the above premises, and draw a wide margin of difference between the establishment of the post offices and roads and that of the telegraph. They maintain that the post office is simply the medium through which the government tenders itself to carry parcels of a limited weight for a limited price, and this entirely regardless as to the contents of the parcels, whether the same be a means of transferring ideas from one person to another, or a mere mass of material substance. The telegraph, on the other hand, is *per se* a medium for transmitting information, and nothing else.

Mr. Lowery elaborates these views with much ingenuity and cogency in his argument. He points out that the post office is an agency, the original design or motive of which was, doubtless, to favor the transmission of intelligence, public or private, between the people: its function is the carrying of packages which *may* contain information. Because this possibility exists, and Congress controls the means of conveyance, therefore it is urged by the advocates of the plan that Congress should control another medium which conveys nothing, but merely transmits information as such—a clearly illogical sequence.

To borrow Mr. Lowery's illustration: Suppose A and B are talking together a couple of feet apart. A crosses the street, and the conversation is still maintained by raising the voices; or one person may go to the garret and the other to the cellar of a house, and yet converse through a speaking tube. They may separate by a wider interval and talk by pre-arranged signals made with their arms; or lastly, they may place an interval of a thousand miles between them, and still continue their remarks by the aid of the telegraphic wire. A's mind meets that of B just as instantly through the telegraphic signals as through the medium of oral words. In the one case a conducting wire, through which a current passes, is the means; in the other, sound-conducting air, through which certain vibrations are transmitted, serves the same purpose. The extension of the telegraph, then, from between A and B to between every individual in the United States and everywhere else, virtually places all the people within the sound of each other's voices. If such were literally possible, then—if the government has the right to control batteries and wires in the one case—it has equally power to control the vocal cords and air in the other: in other words, to prevent people talking to each other save on the payment of tax—a *reductio ad absurdum* too palpable to need further demonstration. Of course the power once in the hands of any government to control interchange of information between the people converts that government into a despotism very different from that contemplated by the Constitution. That instrument, however, is a rigid one; and as it distinctly says "establish post offices and post roads" and "regulate commerce," and does not say anything about controlling information (however transmitted), it may be taken as reasonably certain that no judicial interpretation would discover in the plain provisions above quoted the degree of elasticity necessary to extend them to an authorization to Congress to assume the ownership of the telegraph lines.

There are many, however, who would be willing to yield a point of right, if the expediency of the change were great. That is, if, by suppressing the private corporations and placing the telegraph under government control, the whole country would be manifestly benefited, not many would be found to oppose any legal means, if such could be reached, for accomplishing the object. But here again we are met by an array of considerations and facts which demonstrate the project to be plainly inexpedient. The latest reports of European government telegraphs show clearly that, instead of being a source of revenue to the countries where the system has been adopted, they are a source of expense. Statistics for 1873 show for the German Empire a deficit of $661,727. France has a very slight surplus; but taking the aggregate receipts of seven countries—Germany, Hungary, Belgium, Denmark, France, Holland, and Switzerland—the expenditures are found to have exceeded them by $1,075,510. As for England, the London *Railway News*, of late date, admits a deficiency of $5,000 a week, and this increasing.

In adverting to this subject before, we pointed out that a comparison of the British tariff with our own, taking into consideration the enormous distances between points in this country, shows in the end that our rates could gain little in cheapness supposing our government to run the telegraph at once as efficiently as that of England now does. Again, the English post office carries letters for a penny, and makes five million dollars a year; ours charges three cents, and, according to Postmaster Jewell's report, there is a deficit of eight million dollars. The Postmaster General may well assert his intention to try and make the receipts and expenditures of the Department bear some proper relation to each other; and we may justly doubt even the accomplishment of this task for some time to come. It is absurd, however, to suppose that, beside this, a postal telegraph could be made into a paying enterprise, and not an additional burden on the taxpayers. There are other objections to the postal telegraph which we have not space here to detail. A government censorship of news is not to be desired in these days of high party feeling; nor is the saddling of the country with an immense host of new officials an inviting prospect—particularly when appointments will probably, as is the case now in other political positions, be governed by every other consideration save that of fitness for the work. The imposition of another tax is also objectionable. The telegraph is not employed by a great mass of the population. As it is now, it costs this class nothing; as it would be, they would be obliged to contribute to its support.

Postmaster Jewell's report, to all appearances, gives the postal telegraph scheme its practical quietus for this session; but as the project is nevertheless likely to be brought up and discussed, it is, perhaps, well that the public should understand wherein it fails both in law and in expediency. If the government chooses to erect or acquire telegraph lines for its own use and benefit, it certainly has the right to do so; but that it should compel the people to employ only those lines, by legislating the great telegraphic corporations out of existence and securing to itself the monopoly, we decidedly disbelieve.

THE TRANSIT OF VENUS.

Cable despatches from three of the American expeditions for the observation of the transit of Venus, respectively stationed in Japan, Siberia, and Tasmania, and from the British parties in India, China, and Egypt, announce the results thus far obtained. Professor E. Hall, telegraphing from Vladivostock, reports that, as the planet advanced and touched the sun's limb, the moment was signaled with accuracy; but owing to the drifting of haze and clouds between, it was impossible to obtain good photographs of the contacts. After Venus had crept half way across the sun's disk, however, thirteen good negatives were secured, so that it will be possible to map the planet's track on the photographic image of the sun after the observers return home. Professor Davidson, at Nagasaki, was also troubled with cloudy weather. The first contact could not be recorded, but the time of the second one was obtained excellently. A large number of accurate measurements were secured, however, and sixty clear photographs. The astronomers of this party were remarkably fortunate, as almost immediately after the occurrence of the phenomenon the sky became thickly clouded.

Messages from the British parties to the Astronomer Royal state that at Thebes, Egypt, numerous fine photographs were taken; and at Cairo and Suez, the closing stages of the transit were viewed under favorable auspices. The reports from Shanghai, China, are discouraging, and announce complete failure of all attempts, owing to the cloudy weather. The Indian observations seem to have been the most successful, upwards of one hundred negatives of the planet's position on the sun's disk being secured. The details of the micrometric measurements and of the instants of contact, it is also stated, were obtained with precision.

Professor Harkness, from Hobart Town, Tasmania, announces bad weather, but good results, in the shape of one hundred and thirteen photographs.

Altogether the reports are encouraging, and point to generally fair success. The despatches of Professors Harkness and Hall are the most important, owing to their stations being far north and far south of the Equator, and hence giving the most trustworthy data.

In this connection we notice a letter, from Mr. Lewis M. Rutherford, to the *Times*, in which he recommends the use of a short telescope and enlargement of the image by the intervention of an enlarging lens between the objective and the plate on which the photograph of the sun is taken, in lieu of

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a long telescope, some forty feet in length. Mr. Rutherford's great success in solar photography, as well as in the photographical record of the positions and aspect of other heavenly bodies, entitle his opinions to the highest consideration; and since his suggestion to the above effect has not been adopted by our observers, the details of the results obtained by using long telescopes will be looked for with interest. If there be any error or difficulties due to the latter cause, it would be a matter of grave public regret that Mr. Rutherford's advice had not been heeded.

Professor C. S. Lyman, of the Sheffield Scientific School, has published an interesting communication detailing telescopic observations of Venus, made from the observatory of the above institution just before the period of transit. When the planet arrived at a distance of only half the sun's diameter from the sun's limb, its appearance became no longer that of a crescent but of an entire ring of light, beautifully delicate, and brightest on the side toward the sun. It is only when the conjunction occurs very near the node that the planet can approach near enough to the sun to have the horizontal refraction of the planet's atmosphere, on the side opposite to the sun as seen from the earth, deflect the solar rays so as to bring them to the observer.

It is to be hoped that other astronomers have watched this interesting phenomenon: for beside its beauty and novelty, it affords, with proper measurements, the means of determining the refractive power of Venus' atmosphere, which would appear to be about one sixth greater than that of the earth.

THE PATENT OFFICE CLERKS.

We are informed by a Washington newspaper that the Commissioner of Patents is proposing to have the force in his office increased without increasing its expenses, by diminishing the pay of some of the old employees sufficiently to provide salaries for the new ones. We hope this statement is untrue. That the present rate of compensation in the Patent Office is not too great is proved by the fact that it is insufficient to secure the desired permanency in official station therein. When a clerk has acquired the experien e and skill that qualify him for the effectual discharge of his duties, he soon finds some more lucrative employment elsewhere. These situations are thus often regarded as stepping stones to the real business of life, and are vacated as soon as the incumbents have fitted themselves for usefulness therein. This state of things will grow worse the more the rate of compensation is diminished. As the higher grades of these clerkships require the highest order of talent and skill, they should be made the object of ultimate ambition and desire to those holding subordinate positions. These should not, therefore, be induced to seek more inviting situations elsewhere, in consequence of inadequacy of compensation here.

If, therefore, a larger number of employees is needed, let them be employed and fully paid; if they are not needed, they ought not to be employed at any price. It is a false economy to fix the s ale of official salaries so low that they will not command proper qualifications in their incumbents, and it is almost an equal mistake to cumber the rooms and halls of the Patent Office with those whose services are not needed. Let all be diligently employed and fully paid.

If we are not misinformed, there are already nearly or quite five hundred persons now on duty in the Patent Office. With proper regulations, and under a well arranged system of labor, we believe that this number is fully sufficient for all the business that will be brought before the Office for many years to come. The funds of the Patent Office have been contributed by the inventors of the world, and should be devoted to their benefit. It is due to them that this fund should not be wasted or needlessly expended. If it is now more than sufficient to meet the annual expenses of the Office, a diminution of the office fees would be a proper corrective; but it ought never to be squandered on a multitude of officials who are willing to serve on half pay.

EZRA CORNELL.

Just as the reports of the astronomers scattered over the remotest portions of the globe, telling of the observations of a great natural phenomenon, are flashing over the wires, the sad intelligence reaches us of the death of the man to whom, next to Morse, the world is indebted for the introduction of that grandest of modern inventions, the electric telegraph. The immediate associate and co-worker with the inventor, his firm adherent through all the dark hours preceding the triumphant success of the derided project, the name of Ezra Cornell will pass to posterity as indissolubly linked to the telegraph as to the noble university which remains a monument to his benevolence and philanthropy.

Mr. Cornell was born at Westchester Landing, New York, on January 11, 1807. His youth was spent working at the potter's trade with his father, but little opportunity being afforded him to acquire more than the rudiments of a common school education. On attaining his majority and for fifteen years thereafter, he was at times a workman in machine shops and at times engaged in agriculture, earning but a slender income. In 1843, he became acquainted with Morse, and at once deeply interested himself in the plans of that inventor. At that period Morse was seeking a practicable way of laying his wires through underground pipes, and called in Cornell's aid to assist him. Cornell soon invented a machine for accomplishing the work, which was successfully used until it was de ided to abandon the underground system in favor of the poles. It is related that this decision was not arrived at until two thirds of the Congressional appropriation, for constructing the experimental line between Baltimore and Washington, had been expended, and it was evident that the balance could not complete the undertaking. Morse then called Cornell aside, and told him that operations must be stopped, but in such a manner that the public would not suppose that they had failed. Cornell at once grasped the handles of his machine and started the eight mules by which it was drawn ahead at a lively pace. By an adroit turn of the wrist when unobserved, he ran his plow point against a rock, wrecking the apparatus, thus demolishing the only means by which the pipe laying could be continued. Subsequent experimenting resulted in the success of the wire elevated on poles, as is well known, but the labors of the inventor and of his faithful friend to raise funds to extend their projects were none the less unremitting. So hard-pushed were they at one time that they opened a show of their instruments in a store on Broadway, asking a small admission fee; but the public failed to appreciate the chimeri al scheme, and the revenue of the partners was very small. Cornell was almost penniless, entirely so at one period, as he afterwards stated that the lucky finding of a shilling in the street prevented his going dinnerless.

With the general recognition of the magnitude and importance of the invention, Mr. Cornell began to reap the returns for his zeal in its behalf. He was employed in the construction of many telegraph lines, through which means, together with the increase in value of the shares of stock which he owned in the Western Union line, he speedily amassed a large fortune.

The early part of his life is a lesson of frugality and perserverance; his closing days furnish a shining example of liberality and benevolence. He struggled until he attained wealth; but riches once gained, he abnegated self, and devoted them to the welfare of mankind. His first public act of philanthropy was the endowment of a public library in Ithaca, New York, on which he expended some fifty thousand dollars. Then followed the magnificent gift, first of $500,000, then of two hundred acres of land with the necessary buildings, and finally smaller donations amounting to $11,000, to found Cornell University, one of the few great educational institutions which aim to teach men to keep themselves, to send out skilled mechanics, graduates capable of earning their bread at once by their own work, not mere book-worms, as ignorant of the world as of how to make it support them.

Mr. Cornell for many years took an active part in politics, filling with honor several State legislative offices. He was also President of the State Agricultural Society, and was largely interested in many railroad, banking, and manufacturing companies. His fatal illness, which terminated on the 9th of December, was induced by overwork in business affairs.

WILL DO IT AFTER A FUNERAL.

It is now considered settled by the most eminent medical authorities that a large percentage of the sickness which prevails in cities, like New York, is due to the backing up of foul gases through sewer pipes into the apartments of dwellings. Against these dreadful odors, the pipe traps commonly used offer but little protection.

There is a very sure and simple remedy, which at a slight cost might be applied in every house in New York; but which, we are sorry to say, is rarely put into use until after there has been a funeral in the family. In the case of the Deaf and Dumb Asylum, in this city, it required several funerals before the parties could be induced to look to the sewers connected with the establishment.

The remedy we allude to is the connection of the house sewer pipes with the kitchen chimney, so that all gases that back up from the sewers will be carried up chimney and not into the house.

We have repeatedly called attention to the excellence of this remedy, have given engravings illustrative of the method of application, have cited instances of its application in other countries, have urged our architects to take special care in drawing up the specifications of new buildings to provide for these escape pipes. We now renew these reminders. Furthermore, we would respectfully ask the eminent and accomplished scientific gentleman who presides over the Board of Health in this city, whether, in his opinion, the introduction of escape pipes as suggested is not a desirable thing to accomplish, regarded from a sanitary point of view? If it is, are there any weighty reasons why the Board should not issue an order forthwith, requiring all landlords to put the pipes in? The Board, we believe, does not lack authority in the matter. It has only to speak the word, and it will be done.

THE LATEST POLAR EXPEDITION.

Dr. Augustus Petermann, the celebrated German geographer, has recently addressed a letter, on the subject of past explorations of the arctic regions, to the British Royal Geographical Society, which is of timely interest in view of the present fitting out of another English expedition to that unknown quarter of the globe. Dr. Petermann believes, from the results already arrived at, that with appropriate steam vessels, making use of the extensive experience gained, the central area will be penetrated as far as the North Pole or at any other points. He also states that the disputed question as to the proper route is clearly settled in favor of passage through Smith's Sound.

Through the individual labors of Dr. Petermann, continued since 1865, seven small expeditions have been sent out. The details of the explorations conducted have not been made public; but generally, from the interior of Greenland, in 30° W. longitude to 59° E, east of Spitzbergen, a width of about ninety degrees of longitude has been surveyed. Besides this, it is now known that the Norwegians, in frail fishing smacks, have circumnavigated Nova Zembla, and have proved that the Kara and Siberian seas are for five months in the year open. The most important information, however, communicated in Dr. Petermann's letter, lies in the extracts from reports by Captain Gray, of Peterhead. From observations made in 1868, this navigator concluded that no difficulty would be found in carrying a vessel to the Pole by taking the ice at about the latitude of 75° (where generally exists a deep bight), sometimes running in a northwest direction upwards of 100 miles toward Shannon Island, thence following the continent of Greenland as long as it is found to sound in the desired direction, and afterward pushing northwards through the loose fields of ice which will be encountered. Captain Gray penetrated northward again during the past summer as far as 79° 45'. At that latitude, in August, the ice was broken up, whereas "down to 77°," he states, "the floes were lying whole in the sea, clearly showing that the ice in 80° must have been broken up, by a swell from the north; beyond the pack to the north (which I could see over), there was a dark water sky, reaching north until lost in the distan e, without a particle of ice to be seen in it."

If two thoroughly equipped steamers be despatched, one up the west coast of Greenland, by way of Smith Sound, and the other up the east coast of the same continent, there is not much question but that one or the other would ultimately reach this open water near the pole, the existence of which so many have credited. It has been the misfortune of late ar tic expeditions that all have been projected on too small a scale; and although they have performed excellent service as pioneers, they lacked the completeness in organization and equipments necessary for the endurance of so long and arduous a voyage.

The preparations for the British expeditions, we understand, are already under way, and the command has been given to Captain George S. Nares, late of the Challenger. We may conclude, therefore, that the long-sought problem of reaching the pole is at length to be met by all the resources of engineering skill and scientific knowledge, in presence of which the solution cannot be far distant.

CHEAP FREIGHTS.

The American Cheap Transportation Association recently met at Richmond, Va., under the presidency of the Hon. Josiah Quincy, of Boston, Mass. Mr. F. B. Thurber read a report on railroads, in which he pointed out various abuses incident to the general management of lines in this country. Among these he mentioned watering stock, fast freight lines run by concerns outside the companies, the present palace, sleeping, and express car systems, and the fact of employees being pecuniarily interested in the use of certain materials and patents. The conclusions were that the most effectual and permanent remedy for the evils is competition, and that the most effective competition will be found in railroads when they are owned by the people. The improvement of water courses and the construction of small canals to connect large bodies of water is also necessary. An exclusive freight road, it is believed, from the grain-growing sections of the West to the seaboard, would demonstrate how cheap freight can be carried by rail; and as soon as this is ascertained, public opinion would soon compel existing roads to abolish the abuses which are absorbing the revenues of the present system.

It strikes us that any candid reader who peruses the columns of the daily journals and endeavors to master the intricacies of the strategic movements of the Pacific roads against the trunk lines, the Baltimore and Ohio against the New York Central, the Pa ific Mail muddle, and the question of the Saratoga agreement, will arrive at no other conclusion but that there is plenty of competition, though the chances of cheaper freights are by no means so generally apparent. The recent completion of the Baltimore and Ohio direct road to Chicago is, it is said, destined to have considerable significance, in that negotiations are pending between its managers and those of the Erie line for a joint use, by the latter, of a portion of the former route, which would render Erie independent of Lake Shore. It appears, however, that, in spite of the pronounced benefits to be gained by the Baltimore and Ohio completion, the published rates of the New York Central are far less already than those of the first mentioned road. Mr. Vanderbilt's table of local freight tariffs, compared with that of the Baltimore road, shows rates averaging in the neighborhood of 40 per cent less for similar distances. For example: From South Branch to Baltimore, 162 miles, is charged 62 cents; from Schenectady to New York, 161 miles, the winter tariff is 50 and the summer 30 cents, all first class. Flour, per barrel, from Parkersburgh to Baltimore is $1.30, 383 miles; from Buffalo to New York, 440 miles, 50 and 70 cents.

The Central besides gives special rates to any one. A like comparison to the above shows that the tariffs on that road are actually less than those asked by the Grangers on the Illinois lines. Finally the comparison of the business done by the New York Central for the past year, as compared with 1873, exhibits an increase of 46,800 tuns in tunnage, and a decrease of $397,972.59 in earnings on freight. This looks more like practical cheap transportation than any project before the public, while it disposes of the charges of illiberality on the part of the Vanderbilt management. Mr. Thurber, in the address to which we refer in our initial paragraph, goes into facts, figures, and an elaborate argument to prove that the New York Central ought to and must charge a much higher rate of freight, because it invests its earnings and issues stock representing the same, instead of using the earnings to improve the road and carrying the balance over as surplus, after the fashion of the Baltimore and Ohio. It is unfortunate for Mr. Thurber that actual figures demonstrate exactly the reverse of his theoretic conclusions.

Eelskins dried and cut in strips make very strong belt lacings.

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THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER VI.

Continued from page 387.

Division number two of the work commences at 79th street, ends at 102d street, and is under the charge of Mr. Sverre Lee, C.E. In this division is embraced a specimen of almost every description of construction upon the road. From 79th street to a point 27 feet 7¼ inches south of the south side of 80th street, a distance of about 173 feet, is a piece of beam tunneling; from this latter point to 92d street extends a section of brick tunneling, 8,237½ feet in length; from 92d street to the north side of 94th street is the rock tunnel, 550 feet in length; from the north side of 94th street to a point 31 feet 6 inches north of the north side of 95th street is the partly rock and partly brick tunnel, 287½ feet long; from this latter point to the north side of 96th street is the tunnel known as the large tapering tunnel, whose length is 250 feet; from 96th street to the north side of 98th street, there occurs an open cut, 537½ feet in length; and finally from this point commences the stone viaduct.

We have in previous impressions described in detail sections of the beam and brick tunnel and open cut, and shall not, therefore, repeat the description in connection with similar work on this section, but merely point out in what respects, if in any, these tunnels differ from the one already described. The beam tunnel at the south end of the division is precisely similar to that on the first division. In the beam tunnel, however, which extends from south of 80th street to 92d street, several noticeable changes have been made. Thus from 80th to the center of 85th street, the roof of the large central tunnel is changed from a semi-circular to an elliptical arch, with a rise of 8 feet 10 inches, as is shown in Fig. 12, page 371. The reason for this change will be apparent by a glance at the profile of the road on page 308, which shows the difference of grades to be too small to admit of an arch of 12 feet 6 inches rise. Again, from the center of 85th street to the south side of 88th street, six rubble masonry abutments are built, so that each of the three arches rests upon two separate abutments of its own; the space between the two inside abutments, east and west (that is, between the abutment of the central arch and the inner abutment of the side arch), is filled in with dry rubble masonry up to the springing lines, and the spandrels above the springing lines with rubble cement masonry. The central arch is also elliptical. From 88th to 92d street, the tunnel is the same as that from 80th street to the center of 85th street. Omitting, for the present, the description of the rock tunnel from 92d to 94th street, we will take up that of the partly rock and partly brick tunnels.

These tunnels begin at the north side of 94th street, where the rock was not of sufficient strength and depth to allow of a rock tunnel, and consist of three brick arches supported upon four abutments of rock formed by three parallel cuttings through the rock. The two outside abutments are chipped off smooth, and lined with 16 inches of brick, carried up to the springing lines, which are 8 feet 6 inches above grade. The two inner abutments are composed of rock, carried up above the springing lines, of an average thickness of 10 feet 8 inches, and lined on the inside of the central tunnel with rubble masonry 3 feet 6 inches in thickness, and on the inside of each of the side tunnels with brickwork 1 foot 4 inches thick, thus giving to each abutment a thickness, inclusive of linings, of 15 feet 6 inches. Through each of these inner abutments are cut two man holes, 7 feet in width and 75 feet apart.

The roofs of the tunnels are semi-circular arches: that of the central arch with a rise of 12 feet 6 inches and a span of 25 feet, and that of each of the side tunnels with a span of 16 feet and rise of 8 feet, each with a uniform thickness of 2 feet. The ventilation is by means of cylindrical shafts, in general character the same as those already described, but only 6 feet in diameter in the clear, and of a depth depending on the difference of grades.

From a point 101 feet 10 inches north of the end of the rock tunnel, the two side tunnels begin to curve in gradually toward the central tunnel, which they intersect 191 feet further north. The radius of this curve is, for the center of the tracks in each of the side tunnels, 1432·7 feet, and for the center of the tunnels themselves, 1772·7 feet. From the point where this curvature starts, the inner and outer abutments are lined, each of them, with rubble masonry 3 feet thick, coursed; the courses being not less than 16 inches, and the joints cut to lay ¼ inch. Owing to the curving of the side tunnels, the inner abutments are made somewhat wedge-shaped, tapering off from a thickness of 15 feet 6 inches at the point of curvature to one of 5 feet at the intersection of the three tunnels. At the end of these tunnels begins the large tapering tunnel. It consists of a brick segmental arch with a span of 68 feet in the clear, and rise of 15 feet 8 inches at the south end, and thence tapering off to a span of 50 feet in the clear and rise of 12 feet 9 inches at its north end, 165 feet further north. The springing lines of the arch are 12 feet above railroad grade, and start from the solid ledge wherever possible. Throughout its entire length, it is lined up to springing line with rubble masonry 5 feet thick. Wherever it springs from the ledge, the skewbacks consist of two courses, and abut against the ledge, hammered off to receive them.

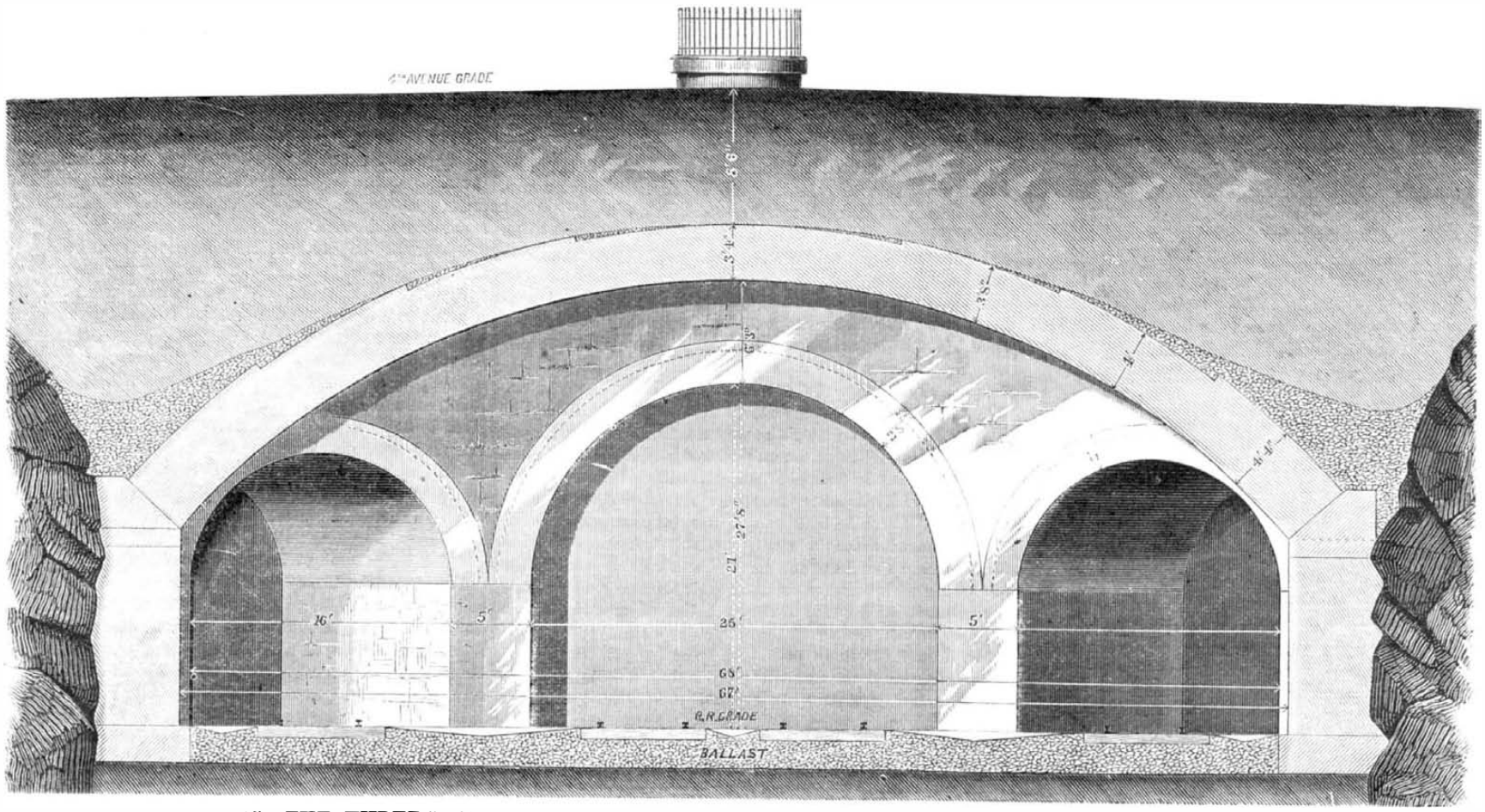

Fig. 15.—THE UNDERGROUND RAILWAY IN NEW YORK.—THE GREAT ARCH NEAR 95th STREET.

The thickness of the arch varies at the springing line and at the crown, and these dimensions again vary with the span. Thus at the south end where the span is 68 feet and rise 15 feet 8 inches, the thickness of the arch is 4 feet 4 inches at the springing lines; a little further up the arch, it is 4 feet; still further up, 3 feet 8 inches, and at the crown, 3 feet 4 inches, thus losing 1 foot in thickness from springing line to crown. At the north end, where the span is 50 feet and the rise 12 feet 9 inches, the arch is 3 feet 4 inches in thickness at the springing line and 2 feet 4 inches at the crown. It will be observed that the arch also loses 1 foot in thickness at the skewbacks between the two ends. This is of course accomplished by a series of three offsets of 4 inches each, passing around the arch, all of which occur at the ventilating shafts. For instance, between the south end and the first ventilator, the arch at the crown is 3 feet 4 inches; from the first to the second ventilator, 3 feet; from second to third 2 feet 8 inches, and from the third to the end of the tunnel, 2 feet 4 inches. The details of this tapering tunnel will perhaps be best understood by a glance at Fig. 15, which represents a cross section of the tapering tunnel taken at the junction of the two side tunnels with the central tunnel, and shows the three tunnels in question, as also the segmental arch with its varying thickness. It will be remembered that the tunnel preceding the tapering tunnel has a total hight from railroad grade to the crown of the arch of 21 feet, and that this tapering tunnel has a total hight in the clear of 27 feet 2 inches. The manner of joining these two tunnels is illustrated in Fig. 16. The roof of the central tunnel, which has elsewhere a thickness of 2 feet, is increased to 2 feet 8 inches for a distance of 5 feet around the face, and on the back of the arch at this point is built a rubble retaining wall, 7 feet 4 inches high, 3 feet at the bottom by 1 foot at the top, which is on a level with the back of the tapering tunnel. The back of the retaining wall is lined with concrete. The joining at the face of the two small tunnels is made in a precisely analogous way.

As this arch is one of unusual span, we shall take occasion in our next article to describe the centering on which it was turned.

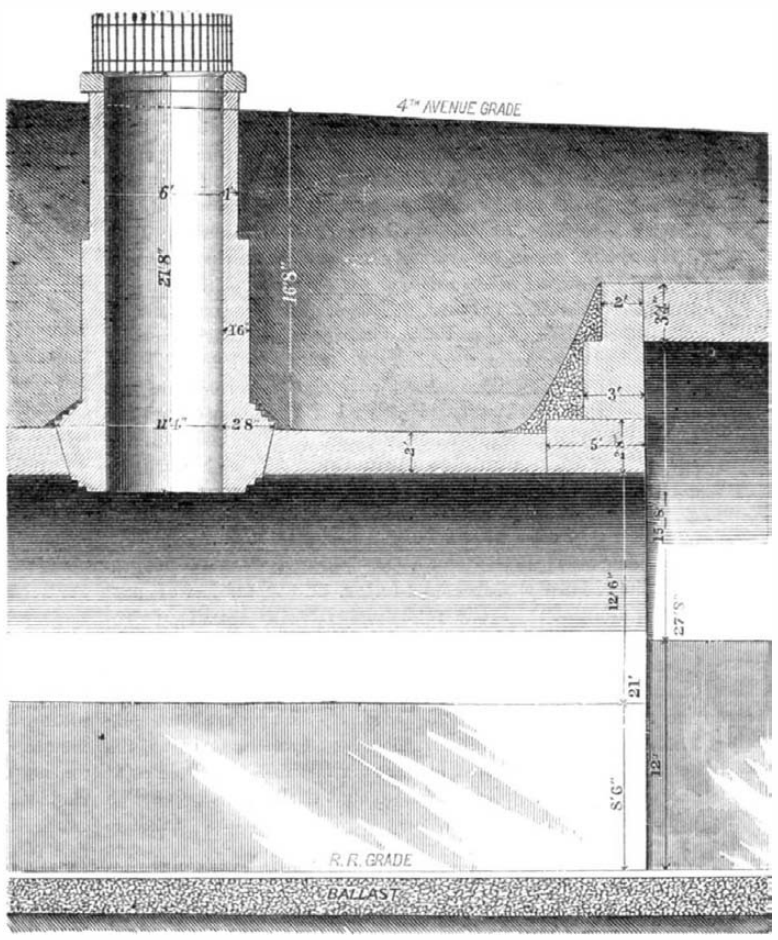

Fig. 16.—THE UNDERGROUND RAILWAY IN NEW YORK. JUNCTION OF THE TUNNELS NEAR 95th STREET.

Immense Photographs.

Photographs have been made of the new Opera House, Paris, 4 feet 3 inches in length, and 3 feet 4 inches in hight. They were obtained in one single piece, by well known processes, and with the aid of a large and specially constructed camera. All the lines of the pictures are of remarkable excellence, the moldings, the busts, the medallions, and even the minutest details being reproduced with rare perfection. The attemp is being made to secure pictures even larger than this.

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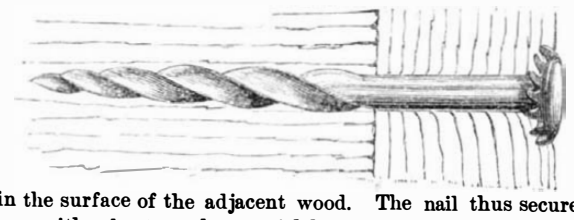
A NEW NAIL.

This is a new form of nail, the peculiar features in which are its screw, shank, and the head concave underneath and provided with teeth. In using it, a hole is first bored in the wood as for an ordinary screw; the nail is then driven in by a hammer, when the teeth about the head will readily catch



in the surface of the adjacent wood. The nail thus secured can neither be turned nor withdrawn without destroying in whole or in part the fibers of the wood.

The invention will doubtless be of advantage in fastening packing cases for shipping, as, in addition to forming a strong connection, its removal, in case of any tampering with the contents, can be at once evidenced by the condition of the box.

Patented March 17, 1874, by Mr. Joseph Lowensohn, of Berlin, Prussia.

CONCEPTION OF THE TELEGRAPH.

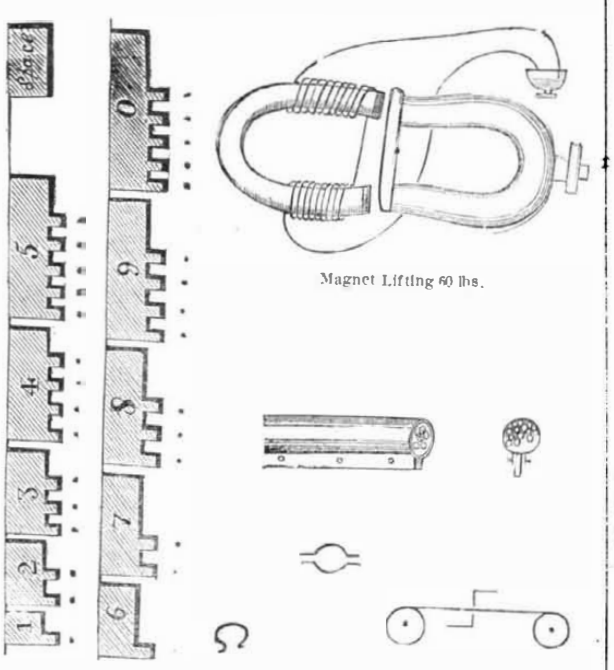
[From advance sheets of the Life of S. F. B. Morse, by S. I. Prime.]

The packet ship Sully, Captain Pell, sailed from Havre on the 1st day of October, 1832, for New York. Among the cabin passengers were the Hon. William C. Rives, of Virginia, returning with his family from Paris, where he had been as Minister of the United States; Mr. J. F. Fisher, of Philadelphia; Dr. Charles T. Jackson, of Boston; Mr. S. F. B. Morse, of New York; Mrs. T. Palmer, Miss E. Palmer, Mr. C. Palmer, Mr. F. Palmer, Mr. W. Palmer, Mr. J. Haslett, Charleston, S. C.; Mr. Lewis Rogers, Virginia; Mr. W. Post, New York; Mr. Constable, New York; Mons. de la Cande, Mons. J. P. Chazel, Charleston; Mr. A. Scheidler, Frankfort, Germany; Mr. and Mrs. Burgy, and others.

In the early part of the voyage, conversation at the dinner table turned upon the recent discoveries in electro-magnetism, and the experiments of Ampère with the electro-magnet. Dr. Jackson spoke of the length of wire in the coil of a magnet, and the question was asked, by some one of the company, "if the velocity of electricity was retarded by the length of the wire?" Dr. Jackson replied that electricity passes instantaneously over any known length of wire. He referred to experiments made by Dr. Franklin with several miles of wire in circuit, to ascertain the velocity of electricity, the result being that he could observe no difference of time between the touch at one extremity and the spark at the other. At this point Mr. Morse interposed the remark: "If the presence of electricity can be made visible in any part of the circuit, I see no reason why intelligence may not be transmitted instantaneously by electricity." The conversation went on. But the one new idea had taken complete possession of the mind of Mr. Morse. It was as sudden and pervading as if he had received at that moment an electric shock. He withdrew from the table and went on deck. He was in mid-ocean, *undique cœlum, undique pontus*. As the lightning cometh out of the East and shineth unto the West, so swift and far was the instrument to work that was taking shape in his creative mind.

The purpose instantly formed absorbed his mind, and to its perfection his life from that moment was devoted. He was the man to do the work. His mind was eminently inventive and mechanical. In his early youth and riper manhood, he had sought out many inventions. His name had long been enrolled among inventors in the Patent Office of the United States. Patience, perseverance, and faith were hereditary traits of his character. He was now forty-one years old.

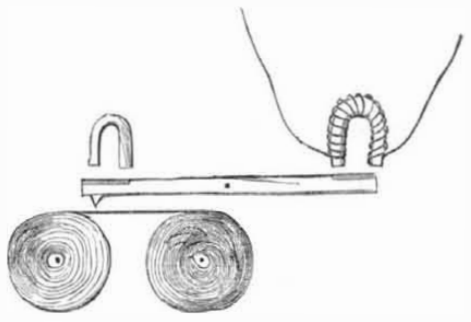
Of all the great inventions that have made their authors immortal, and conferred enduring benefit upon mankind, no



ORIGINAL SKETCHES FROM MORSE'S NOTE-BOOK.

one was so completely grasped at its inception as this. His little note or scratch book was always at hand, in which he made sketches of objects which met his eye, or of images formed in his mind. Scores of these books are now in exis tence, in which his earlier and later pencilings are preserved As he sat upon the deck after the conversation at dinner, he drew from his pocket one of these books, and began to make marks to represent letters and figures to be produced by the agency of electricity at a distance from the place of action. First, he arranged ten dots and lines so as to represent figures referring to words. Next, he drew the wires in tubes. Then came the magnets, and by and by cog rules, to be used in regulating the power. In the course of a few days his book presented several pages of the first marks ever made in the invention of the Telegraph. [All of these drawings and marks are given in facsimile in the volume.]

He wrought incessantly that day, and sleep forsook him in his berth that night. His mind was on fire. In a few days he submitted these rough drafts to Mr. Rives, who suggested various difficulties. But Mr. Morse was ready with a solution. Mr. Fisher states that Mr. Morse illustrated to him his signs for letters, to be indicated by a quick succession of strokes or shocks of the galvanic current, to be carried along upon a single wire. After several sleepless nights, while his mind was in labor with the subject, he announced it at the breakfast table, and explained the process by which he



FACSIMILE OF THE ORIGINAL SKETCH, MADE BY MORSE, OF THE ELECTRIC TELEGRAPH—TAKEN FROM HIS NOTE BOOK.

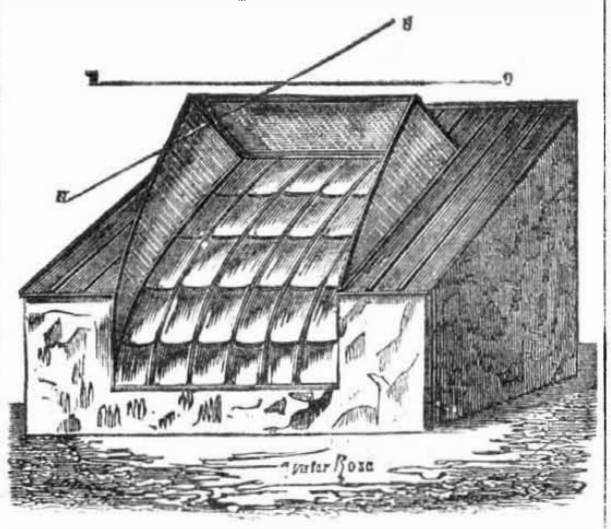
proposed to accomplish it. He then exhibited the drawing of the instrument, by which he would do the work, and so completely had he mastered all the details that five years afterward, when a model of this instrument was constructed, it was instantly recognized by Captain Pell and others, as the one he had devised and drawn in his sketch book, and exhibited to his fellow passengers on the ship.

Captain Pell says: "Before the vessel was in port, Mr. Morse addressed me in these words: 'Well, captain, should you hear of the telegraph, one of these days, as the wonder of the world, remember the discovery was made on board the good ship Sully.'"

Thus it appears from his own records, and the recollections of the captain and passengers, gentlemen of the highest respectability and intelligence, that on shipboard Mr. Morse had actually drawn out and recorded a system of signs, composed of a combination of dots and spaces, to indicate letters, figures, and words, and a mode of applying the electric or galvanic current so as to make these signs permanent upon paper, to be passed along in the instrument which he had invented. The INVENTION was accomplished and announced ere the inventor set foot on his native shore.

FRENCH PHOTO SKYLIGHTS.

"In France they do not have as much sunshine as we; therefore," says Mr. Wilson, in the Philadelphia *Photographer*, "the construction of the skylight has had even more attention there than we give it. Every device is employed for securing a proper light, and a proper quantity of it, and for avoiding anything that may obstruct it. We all know how many skylights are obscured by an accumulation of dirt and dust and rain on the outside. I have known of several cases where photographers have complained that their lights continued to work slower and slower, when, had they looked upon the outside, the guilty cause would have been very apparent. But, in a measure, to avoid that labor, the French use the plan made plain by the figure annexed. It is not without several advantages.



FRENCH PHOTO SKYLIGHT.

"It is similar to the ordinary construction, differing, however, in form. The sash is curved. The advantage of this arrangement is alluded to above, and to do away with the beam which absorbs the freest and is most actinic part of the light, since it strikes the sitter at precisely an angle of 45°. The other part of the roof may be sloping both ways, the proportions of the *atêlier* and the glass sash remaining as ordinarily. At each end of the glass *atêlier* a space may be set off of about ten feet in length on the whole width of the room, to be used as a laboratory and dressing room. The room will thus have a total length of eighteen meters, or about twenty-three feet.

For the portrait photographer who is sometimes obliged to accommodate the sitter who cannot come to his *atêlier*, the

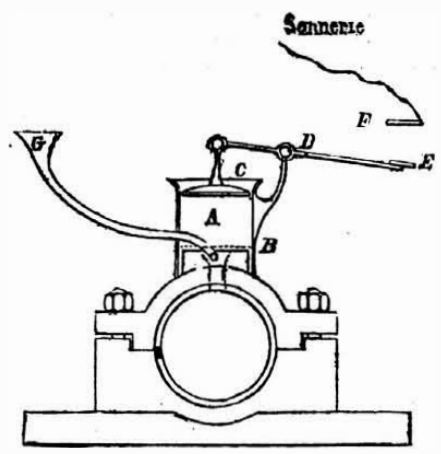
FRENCH PHOTO TENT.

annexed engraving of a tent, forming a posing room, will be found useful. The front faces the north in northern latitudes, and is turned, on the contrary, to the south in southern latitudes. Use a gray blue cloth background, which is about six feet wide by seven feet high. In travelling, it is rolled around the supporting pole; the top and the sides, forming curtains, are made of thin stuff, and held by rings to the rods of the framework, which are taken apart with great ease, to be packed into a very small compass.

In this portable *atêlier*, excellent portraits may be obtained, and the time of posing is one half less than in a glass house. The professional photographer and the amateur will be henceforth able to work with advantage in the open air, and obtain very fine negatives of portraits and landscapes, with a bagage relatively light and easy of transportation.

A Hot Bearing Alarm.

This device, the diagram of which we extract from the



Revue Industrielle, consists in a cylindrical box, A, provided with a perforated bottom, B, and placed directly over the journal. The box is filled with a prepared grease which melts at a certain temperature, to which it must be raised by the shaft becoming hot. As the compound liquifies and escapes through the perforations, a disk, C, which rests thereon, descends, thereby tilting the lever, D, and so making contact between the plates, E and F. The latter are connected by an electric circuit with a bell which sounds when the current is established. The pipe, G, serves for the ordinary lubrication of the journal. It is suggested that this device might be profitably used upon journals not readily accessible.

The Shipping of the World.

The *Repertorio Generale della Marina* for 1874–75, recently published, gives some interesting statistics respecting the number of sailing ships belonging to the different nations in the world, with their tunnage. It may be remarked, however, that the following only relate to seagoing ships, vessels for inland navigation not being included:

Nationality.	No. of ships.	Tunnage.
British	20,538	5,383,763
American	6,869	2,181,659
Norwegian	4,464	1,349,138
Italian	4,343	1,227,816
French	3,780	736,326
German	3,483	852,789
Spanish	2,674	509,767
Greek	2,063	406,937
Swedish	1,905	360,368
Russian	1,428	330,350
Dutch	1,418	385,301
Danish	1,239	173,480
Austrian	955	327,742
Portuguese	410	92,808
Turkish	277	43,360
South American	219	82,761
Central American	138	46,580
Belgian	51	17,158
Asiatic	35	13,527
Total	56,289	14,523,680

The same publication gives the total tunnage of the steamships of all nations to be 5,244,888, of which 3,015,773 tuns belong to England.

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[International Review.]

THE CONSTITUTION OF THE SUN.

BY PROFESSOR C. A. YOUNG.

Number II.

THE PHOTOSPHERE.

As to the nature of the photosphere, or visible surface of the sun, all the observable phenomena, with hardly an exception, concur in representing it as a sheet of luminous cloud: its peculiar granulated structure, the swift mobility of its constituent filaments, and the remarkable appearances, presented by the spots and faculæ, are all consistent with this idea and readily explained by it. And if, as is most likely, according to what has been said, the main body of the sun is in fact a huge globe of mingled vapors and gases at such a temperature that even the enormous force of solar gravity can only reduce them to a density a little greater than that of water, it is perfectly easy to account for the existence of such a cloud sheet: it is simply a necessary consequence of the cooling of these vapors at the outer surface of the globe, where they come in contact with the cold of space. Under such circumstances condensation must result, for just the same reasons and in the same manner as that which produces the water and snow clouds of our own atmosphere: minute drops or flakes must be formed, not of water and ice indeed, but of the materials which we know to exist upon the sun, and must descend in fiery rain and hail into the central depths to be again reëvaporated. And as the descending matter is continually replaced by fresh supplies from below, there must result a vertical circulation of ascending streams and jets of vapor contesting the supremacy with down-pouring cataracts and sheets of the products of condensation; and in consequence the upper surface of the cloud layer must be in a state of continual and intense disturbance, as observation directly shows.

For it is found that the solar surface, when examined with a powerful telescope, is by no means uniformly bright, but mottled with a peculiar texture which has been very variously described, but may well enough be accounted for by supposing it to be formed of columnar clouds, floating vertically in the atmosphere of vapors out of which they are formed. Here and there the surface is marked by brilliant streaks known as the faculæ, most conspicuous near the edge of the sun's disk, which on account of the absorption of the solar atmosphere is much less brilliant than the center. They are simply photospheric clouds, whose summits rise above the general level of the surface, and sometimes form visible projections on the limb. But the most singular objects, and the most interesting, are the spots, whose origin and phenomena have as yet, we think, failed to receive any completely satisfactory explanation. They are dark blotches of exceedingly irregular form, and consist essentially of two parts, a central "umbra," as it is called, surrounded by a lighter fringe known as the "penumbra." The umbra contains usually one or more rounded spots much darker than the rest, and known as "nuclei;" even the darkest nucleus, however, is dark only by contrast with the intenser light around; for when, by means of a peculiar eyepiece, invented by Mr. Dawes, who first discovered these nuclei, we examine the umbra, excluding all light from the surrounding regions, it is found that even the darkest points are far too bright for the unprotected eye; and by the help of Professor Langley's polarizing eyepiece the color is seen to be a purple tint, closely matching that portion of the spectrum near the fixed line, H.

That the spots are hollows, having a depth varying in different cases from two to ten thousand miles, may be considered as an established fact, admitted now almost without dissent. The spectrum of the umbra of a spot is found to differ from that of the neighboring portions of the solar surface, first, in a general darkening of the whole; second, in a widening and deepening of many of the dark lines, with, on the other hand, a thinning and sometimes even an actual reversal of others; and third, in the presence of certain dark bands, sharply terminated on one edge, but shading gradually on the other. Now all these phenomena are just what might be expected in a cavity filled to a great depth by the nearly transparent gases which elsewhere form a thin layer over the sun's surface.

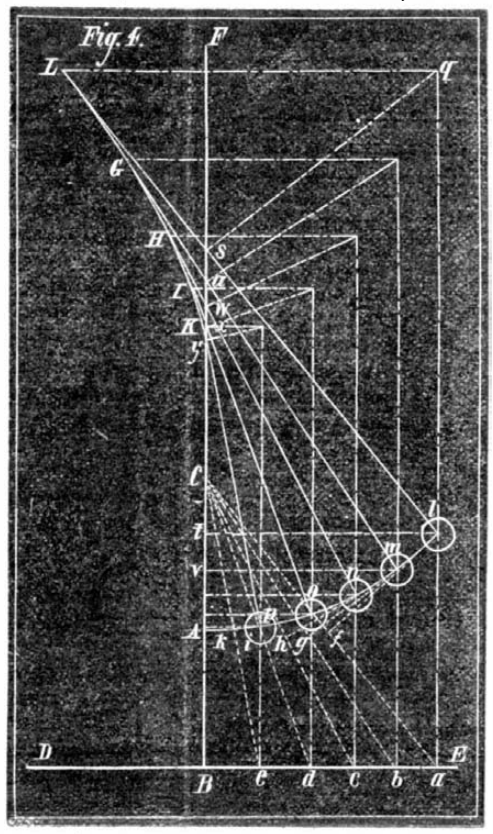
Spectroscopic observations on the chromosphere also show that around the spot there is an unusual and violent up-rush of hydrogen and other materials from the central depths.

There is a well marked periodicity in the frequency and violence of our magnetic storms and their accompanying auroras, which exactly corresponds to that of the solar spots.

PENDULUM GOVERNORS.

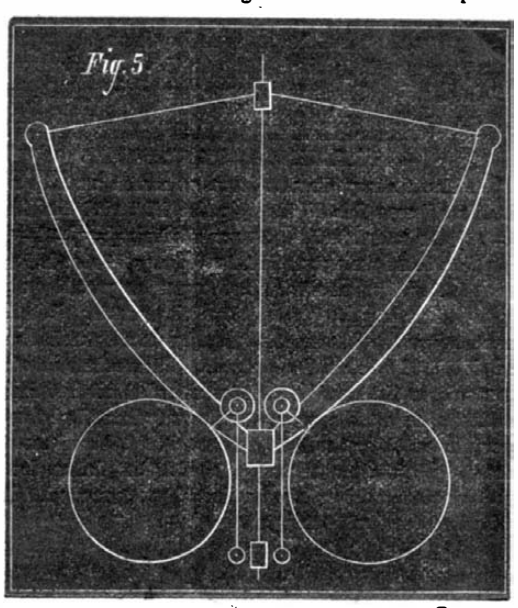
Number II

A governor in which the hight of the balls is always the same, whatever their position, is said to be isochronous. In such a governor, the balls can only maintain the middle position, corresponding to the ordinary load on the engine, when the latter is at its proper speed, any change of speed causing the governor to act upon the regulator in such a manner as to correct the variation at once, if sufficiently powerful. In order to fulfil this condition, the centers of the balls, as they change their positions, must describe arcs of parabolas, as illustrated in Fig. 4, the curve, *t m n o p* A, being a parabola. It will be seen that, as the ball changes its position, so does the point at which the center of the ball rod cuts the center of the spindle, so that the vertical hights from center of ball to these points are always the same. In this form of parabolic governor, the end of the governor rod is made of flexible steel, and is hung to the end of a curved check, L G H I K, which is called the evolute of the parabola. The construction of the parabola and its evolute are shown in Fig. 4. The weight of balls, length of arms, and resistance to be overcome are first ascertained; and from these, the hight of the balls can be calculated when the engine is at speed. Then draw two lines, B F, D E, at right angles to each other.



Make B C equal to the calculated hights. From C, draw any number of lines, C *e*, C *d*, etc., to D E, and, at each point of intersection, erect a perpendicular to D E. From the middle point, *k*, of C *e*, draw a perpendicular to C *e*; the point, *p*, in which it meets the perpendicular through *e*, is one point of the parabola. Bisect each of the other lines, C *d*, C *c*, etc., by perpendiculars, and the points in which these perpendiculars cut the perpendiculars drawn through *d*, *c*, etc., will be other points of the parabola. From each point so determined, as from *l*, draw a line, as *l s*, parallel to the line drawn through C, to determine the given point. From each point, as *s*, in which this line cuts B F, erect a perpendicular, as *s q*, and from the point in which it cuts the perpendicular, as *a q*, through the given point of the parabola, draw a line, as L *q*, parallel to D E, till it meets the line, as *l s*, first drawn. In this way, points L, G, H, I, K, of the evolute of the parabola, are determined.

Another manner of making the balls move in parabolic



arcs is shown in Fig. 5, the balls sliding up along parabolic guides, as they change their position.

It has been shown that the weight of the balls does not affect their position, if the governor has no resistance to overcome beyond the weight of its own parts. In practice, however, a governor acts upon the controlling mechanism, and should have its balls proportioned so as to exert the requisite force. The necessary weight is thus calculated: Measure the distance of the point of suspension of each ball from its center. If there is a sliding weight, measure also the distance from its center to each point from which it is suspended. Ascertain the resistance of the controlling mechanism in pounds, and measure the length of the connections by which the governor overcomes this resistance, from their points of suspension to their points of attachment with the controlling mechanism.

1. Multiply each weight or resistance by the length of its connection, and divide by the length of the ball rod; add these quantities together, and divide them by 2.

2. Assume the greatest speed of governor that will occur under variation of load on the engine, subtract the proper speed of governor from this number, and divide by proper speed.

3. Divide the quantity obtained by the first part of the rule by the second quantity. The result will be the weight of the two governor balls.

This rule is somewhat complex, and it may be simplified by applying it to an example.

The ball rods of a governor are each 12 inches in length; there is a weight of 30 pounds connected to the spindle by a lever 9 inches in length; the resistance of the controlling mechanism is 20 pounds, and the rods connecting this mechanism with the governor are each 1½ inches long. The governor is connected with the engine so as to make 300 revolutions per minute when the engine is at speed, and the greatest number of revolutions per minute under variations of speed is to be 350. What is the proper weight for each ball?

1. Multiplying the weight on the spindle of 30 pounds by 9 and dividing by 12, we obtain 22·5 pounds as the equivalent weight, if its connection were of the same length as those of the balls. Similarly, the equivalent resistance of the controlling mechanism is 15 multiplied by 1½ and divided by 12, or 2·5 pounds. The sum of these weights is 25 pounds; and dividing by 2, we obtain 12·5.

2. The difference between the greatest number of revolutions of the governor per minute and the proper number is 50, and this, divided by 300, is 0·167, nearly.

3. Dividing 12·5 by 0·167, we obtain 74·85+ pounds, so that the weight of each ball should be about 37·5 pounds.

It will be evident, from what has preceded, that a pendulum governor which is very sensitive cannot be very powerful, nor one which is very powerful be very sensitive; and that, in order to obtain great power, it will be necessary to use very heavy balls. Our readers have, doubtless, observed that those governors which give the best satisfaction are arranged with a view to sensitiveness, the controlling mechanism being actuated by the application of a very slight force. It is probable that governors of any design will be subject to similar conditions, since a great resistance in general requires considerable force to overcome it.

We have been at great pains to simplify the rules contained in this article, and we think our readers, by applying them to a few examples, will readily understand them. The principles stated are of interest and value to all who are engaged in the construction of governors.

Correspondence.

The Patent Office Tea Set.

To the Editor of the Scientific American:

In answer to your inquiry as to what has been done in reference to the illegal presentation to Commissioner Leggett, I would say that it was stated on good authority that the Assistant Secretary submitted the question to the Attorney General for his opinion, and that it was finally concluded to drop the matter, and do nothing about it.

That it was a plain, open violation of the law is clear, and is admitted by the more honest of those who participated in it. The leading ones—those who headed the subscription and gave the most, some of whom are soon to come before the Senate for confirmation—fearing the effect of their illegal act, now seek to evade it by denying that they gave anything. The ground on which they do this is that, although they subscribed, they did not pay their subscriptions until after the 1st of November, which was some time after the plate was purchased and presented. Possibly, in order to avoid the effect, they may not have paid it yet; but that the present Commissioner headed the list with $50, and the Assistant Commissioner followed with $25, or more, is not denied, and cannot be, truthfully. This, to say the least, is a most cowardly and mean attempt to crawl out and leave blame to fall on the subordinates, nearly all of whom subscribed under compulsion: merely to retain the goodwill of those in authority, or to come in, and thereby to retain their places or secure promotion.

Again, they urge that they did not violate the law, because the subscription, although made early in October, was dated November 1, so as to have it appear that it took place after the Commissioner was out of office. This only makes the matter worse, because it shows on its face a knowledge of the law, and a deliberate attempt to evade its plain provisions.

Again: they urge that it was at best but a technical violation, because, although legally Leggett's resignation did not take effect until the 1st of November, still practically he was already out of office. The trouble with this is that it is not true, for not only did he remain until after the presentation (October 19, I think it was), but the Office records show that he acted as Commissioner and made decisions after that—at least so I am informed and believe. It has also been stated that this matter of the presentation originated with the lady employees. This is not true, and it is all the more unmanly for these parties to seek to shift the responsibility from their own shoulders to those of the women. A certain woman did originate, or at least carry out, the plan of presenting the cane; but the tea set presentation originated with, and was carried out by, the male employees. A certain examiner, who hoped and expected to be made Assistant Commissioner, was the main mover in the matter, and personally circulated the subscription paper.

Not only was the whole proceeding a palpable and wilful violation of the law, but they were so told at the time, by some who refused to subscribe, for that among other reasons. The whole matter, both in the transaction itself and in the neglect to enforce the penalty of the law by the Secretary, is but a fair illustration of the contempt for the law manifested of late by the Patent Office officials. JAMES.

GREAT BRITAIN has formally accepted the invitation of the United States to contribute to the Centennial.

THERE is no mode so effectual to impress ideas on the mind as that of experiment aided by reflection.

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PRACTICAL MECHANISM.

NUMBER XIV.

BY JOSHUA ROSE.

In the experiment referred to in our last, the valve had (in the first instance, when it had no lap) one sixteenth inch of lead so as to give that amount of exhaust opening when the piston was at the end of the stroke. In the second instance, however, when the valve had $\frac{5}{16}$ of steam lap added to it, it was set so as to have not more than $\frac{1}{64}$ of lead, the author being convinced that, when a valve has sufficient lap to give a moderately free exhaust, there is more to be lost by back pressure from excessive lead than to be gained by the small amount of assistance it lends towards making the exhaust more free. If a valve has no lap at all, it may with advantage be given an amount of lead that would otherwise be decidedly detrimental. It would appear that, in the early days of steam engineering, one of the advantages due to adding lap to the valve (a free exhaust) was largely attributed to the lead of the valve, since sufficient lap to cut off the steam supply when the piston has traveled three quarters or even more of its stroke will give a sufficiently free exhaust, even supposing that the valve has no lead at all.

Referring again to the advantage in economy due to using (or, as it is commonly called, working) the steam expansively, it is self-evident that, if we have steam at a gage pressure of 50 lbs. per inch, (that is, above the pressure of the atmosphere) and permit its escape at any pressure above that of the atmosphere, we shall not have extracted from it all the power it contains, because it may be used at the initial pressure of 50 lbs. per inch during a certain portion of the stroke, and, by then being permitted to expand itself before being exhausted, may be employed to perform duty as steam of 49, 48, 47, etc. lbs. per inch, and so on down to that point at which the indicating needle or hand of the steam gage will stand at zero, denoting that there is no longer any pressure in the steam. This last, however, is not actually the case, since the pressures marked on the gage are in each case 15 lbs. per inch less than the actual pressure of the steam when the needle stands at that point, which 15 lbs. serves in a high pressure engine to overcome the atmospheric pressure: which, in consequence of the exhaust port being open to the atmosphere, acts upon the exhaust side of the piston as back pressure, and therefore has to be overcome by an equal pressure of steam on the opposite side of the piston; so that, when a high pressure engine uses its steam expansively, so that it exhausts at the gage pressure of zero, it has extracted from the steam all the useful effect possible in such an engine, but at the same time not all the useful effect or power which the steam contains, as will be hereafter explained. This leads us naturally to another consideration, which is that, if steam be used expansively in a high pressure engine to an excessive extent, the result is an actual loss of power, because, if the steam on the one side of the piston is at a pressure less than the atmospheric pressure on the other, the latter acts of course as a retarding force to the advancing piston.

The steam passages between the valve seat and the cylinder bore, and the clearance between the piston (when it is at the end of its stroke) and the cylinder cover, are spaces which have each to be filled, during each revolution of the engine, with live steam; and if the engine is not worked expansively, this live steam escapes without giving any of its power to the engine, and is lost, except in so far as it was necessary to fill those spaces. If, however, the engine is worked expansively, the expansive force of such live steam is extracted from it and applied as useful effect upon the piston, the result being an appreciable gain in the economy of steam, especially in those engines which, by reason of having the valve seat in the center of the cylinder, have very long steam passages, not merely because of the length of such passages, but also because in such cases the steam port serves alternately as the exhaust port, and has therefore to be made of larger proportions than it would need to be if employed as a steam port only, since an exhaust port always requires to have a larger area than a steam port. Hence the content of such passages, together with the clearance before referred to, bears a large proportion to the whole contents of the cylinder; and to extract power from the steam contained in them, by utilizing its expansive force, is a considerable gain to the engine.

From what has been already said, it will be perceived that a high pressure engine, to work to the greatest possible advantage and economy, should work its steam expansively to such a degree that it will be exhausted at zero of the pressure gage, or in other words at a pressure of 15 lbs. per inch, that being equal to the pressure of the atmosphere on the exhaust side of the piston. The point in the stroke at which it may be necessary to cut off the supply of steam to the cylinder, in order to effect such an amount of expansion, will vary according to the pressure of the initial steam and the length of the stroke of the engine, and must hence be determined according to those conditions.

An approximate calculation, as to what extent the steam in a cylinder is working expansively and its pressure at the termination of each inch of piston stroke, may be made by making the whole distance the piston has moved (under both live and expansive steam) the denominator and the distance it has moved under expansive steam the numerator of a fraction, and then multiplying the initial pressure by the numerator and dividing by the denominator of the fraction; then subtract the quotient from the initial pressure, the last product being the pressure of the steam. Thus: Supposing the initial pressure of the steam admitted to a cylinder to be 60 lbs. per square inch, the length of the piston stroke to be 20 inches, and the supply of steam to the cylinder to be cut off by the valve when the piston has traveled 5 inches of its stroke, what pressure of steam will there be in the cylinder when the piston is at the end of the tenth and twentieth inches of its stroke, respectively: Here the tenth inch of stroke—whole distance moved by the piston $=10$, distance moved by the piston under expansive steam $=5$, hence the fraction $\frac{5}{10}$; then the initial pressure $60 \times 5 = 300 \div 10 = 30$; then $60 - 30 = 30 =$ the lbs. pressure on the piston when it had arrived at the end of the tenth inch of its stroke.

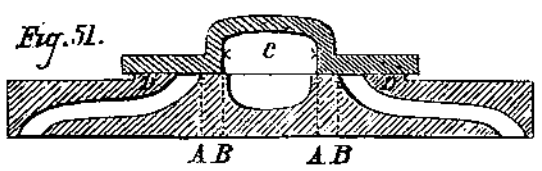
Again: Whole distance moved by piston $=20$ inches, distance moved by the piston under expansive steam 15 inches, hence the fraction $\frac{15}{20}$; then the initial pressure of the steam $60 \times 15 = 900 \div 20 = 45$; then initial pressure $60 - 45 = 15 =$ the pressure of the steam in pounds per inch at the end of the twentieth inch of the stroke or piston movement.

By making such a calculation for every inch of the piston movement and setting the figures in a column and adding them together, and dividing their sum total by the number of inches in the stroke, we arrive at a tolerably accurate estimate of the average pressure of the steam upon the piston throughout the stroke.

A review of the above calculations discloses that, as before stated, the pressure of the steam has decreased in precise ratio to the increase of the space it occupied, that is to say, when the piston was at the end of its fifth inch of stroke (the steam supply being cut off) there was five inches of the length of the cylinder filled with steam at a pressure of 60 lbs. per inch; and when the piston was at the tenth inch of its stroke and the steam had expanded so as to occupy ten inches of the length of the cylinder, the pressure was reduced to 30 lbs. per inch; and the same rule applies to the twentieth inch of stroke, for the steam then occupied four times the space it did as live steam, and had therefore fallen to one fourth of its original or initial pressure. It is to be noted, however, that while such a calculation is absolutely correct as applied to any one definite point of the stroke (making no allowance for the steam in passages and clearance) it is not entirely correct in its results if we take a number of such points to obtain therefrom the actual average pressure of steam throughout the stroke, for the following reason: Suppose we calculate (by the given rule) the pressure of the steam per inch upon the piston when it had concluded its sixth inch of stroke. Here the whole distance moved by piston $=6$ inches, distance moved under expansion $=1$ inch, therefore the fraction is $\frac{1}{6}$; then the initial pressure $= 60 \times 1 = 60 \div 6 = 10$, then again initial pressure $60 - 10 = 50 =$ pressure of steam per inch upon the piston at the termination of its sixth inch of stroke. Now while 50 lbs. per inch accurately represents the pressure of steam upon the piston at the termination of its sixth inch of movement, it in nowise represents the average pressure of steam per inch during the whole inch of movement, because the piston commenced that inch of its movement or stroke under 60 lbs. pressure of steam per inch, and not until it had concluded that inch of movement was the pressure reduced to 50 lbs. per inch. Nor will it avail us to take the mean between the two, that is 55 lbs. per inch, as the average pressure for that inch of movement; because, so long as we calculate the pressure at every inch of the stroke, we shall have the same discrepancy between the pressure at the beginning and at the end of the inch of movement, whether it be at the fifth, sixth, or seventh inch, or at $5\frac{1}{2}$, $6\frac{1}{2}$, or $7\frac{1}{2}$ inches of the stroke. To get a more nearly correct result, we must take a greater number of points in the stroke such as every half or quarter inch of the piston movement; the more points taken, the more nearly correct will be the result obtained. It is, however, generally considered as sufficiently correct for practical purposes to take as many points as there are inches in the piston stroke.

With a common slide valve, it is not practicable to cut off the steam supply to the cylinder sufficiently early in the stroke to effect so large a degree of expansion; because, in the first place, it would require the valve to have an excessive amount of steam lap, and the exhaust would take place too early in the stroke, thus causing the piston to travel a large proportion of the latter part of the stroke without having any pressure of steam behind it; and because in the second place, when there is the large amount of steam lap on the valve necessary to cut off earlier in the stroke than at two thirds (that is, carrying full steam two thirds of the stroke) the admission, expansion, and exhaust of the steam to, in, and from the cylinder becomes very irregular in the forward as compared to the backward stroke of the engine, which irregularity will be shown and treated upon in connection with the piston movement, steam supply, etc. To obviate the defect (above referred to) of a too early exhaust, the valve may have lap added to its exhaust side, that is to say, the exhaust port of the valve may be made narrower than the width between the two nearest together edges of the steam ports of the cylinder face, as shown in Fig. 51, C being the exhaust

Fig. 51.



port of the valve and from A to B being the lap on the exhaust side. Such lap is, however, only possible when there is a good deal of lap on the steam side of the valve.

The amount of exhaust lap is at all times to be governed by the speed at which the engine is to run. A fast running engine, cutting off its steam supply at about one half stroke (which is the extreme limit of expansion permissible with a slide valve), may have exhaust lap to half the amount of the steam lap; a slow running engine may have exhaust lap to nearly three quarters of the amount of the steam lap. The reason of the difference is that, as the exhaust lap retains the steam in the cylinder longer, it, to that extent, cramps the exhaust; and as a quick running engine requires a more free exhaust than a slow running one, the latter may have its exhaust more covered by the exhaust lap when the piston is at the end of its stroke.

The objection to a valve having clearance is the open communication permitted between the steam and exhaust ports, which, though it exists for only a comparatively insignificant space of time, is a radical defect, especially when it is borne in mind that, as we have already shown, a slide valve should always have steam lap, and therefore will always have a proportionate amount of exhaust opening, in addition to that given to it by the lead of the valve. Clearance, then, is an expedient which should never be resorted to, it being a blunder applied merely to remedy a blunder. Clearance to a valve having much lap on its steam side is altogether inadmissible, since it is not requisite to give a more free exhaust, while it assists in letting the exhaust steam escape earlier in the stroke; and by this means, it adds to a defect inherent in slide valves having much steam lap, which is a too early exhaust.

A slide valve is sometimes given what is called clearance, that is to say, it is made wider in its exhaust port than are the two nearest together edges of the steam ports, so that (referring to Fig. 51) the port, C, of the valve would overlap the steam ports to the amount of the clearance, giving to them both an open communication with the port, C, and therefore with each other during the instant of time at which the valve is in the center of its travel. Clearance on the exhaust side is therefore the very opposite of lap on the exhaust side of a valve. The object of clearance is to give the valve a more free exhaust, and it is therefore only resorted to in cases where, the valve having little or no steam lap, the exhaust steam cannot freely escape.

Common slide valves, however, work to better advantage when the lap is so proportioned as to cut off the steam at from two thirds to three quarters of the stroke than at any other point, because of the comparatively long stroke of the valve (and hence large eccentric) necessary when much steam lap is brought into requisition, and because of the large amount of friction between the valve and cylinder faces in consequence of the pressure of the steam on the back of the valve. There are of course many devices for balancing such valves and some for reducing the pressure to a minimum, but none have as yet appeared whose benefits have proved such as to cause their general adoption for locomotives or small stationary engines, to which the application of the common slide valve is now almost universally confined.

To reduce the friction to a minimum, that part of the cylinder face upon which the face of the slide valve works may be raised above the general face upon which the steam chest beds, as is shown in Fig. 51, so that the steam lap of the valve may have the steam on the under as well as the outer side, and be to that extent relieved of the outer pressure. In such case, the width of the projecting faces (marked D in Fig. 51) should not be any wider than is the bridge (of the cylinder face) between the steam and exhaust ports; otherwise the wear of the face of the bridge will be the greatest and the valve seat of the cylinder face will wear hollow, the valve springing (to fit such face) from the steam pressure on its back. Especially is this the case where a high pressure of steam is employed. It is not uncommon to cut away these faces, leaving them full only around the edges of the ports, which cutting is performed by a slotting drill.

It is advantageous to make the steam ports long and narrow rather than short and wide, so that, when the valve commences to open, whether it be on the steam or exhaust side, a small amount of opening will present a comparatively large area for the ingress or egress, as the case may be, of the steam; hence the supply and exhaust of the steam to the cylinder will be larger in proportion to the valve movement, and therefore more instantaneous. A long port will of course entail a broader valve surface, and hence increased pressure of the valve to its seat; but this is compensated for by the decrease in the stroke of the valve (and hence in the diameter and stroke of the eccentric) permissible with the long port.

The rule sometimes given by which to calculate the required area of a steam port is, say, for a fast running engine: One eighth the area of the piston is the proper area of the steam port; the employment of such a rule, however, gives a result bearing no definite relation to the piston speed, and leaves a wide margin of difference, since either 300 or 600 feet of piston travel per minute is a fast running engine; whereas the amount of steam required to pass through the port for the one speed (supposing both pistons to be of equal diameter) is double that required for the other; while if the port area is larger than necessary, it causes a serious loss of steam; whereas if it is too small, it wiredraws the steam and fails to supply steam at full pressure to the cylinder. The following rule, given by Mr. Bourne, appears to meet the exigencies of the case, by giving the port an area proportionate to the quantity of steam required to pass through it. The rule is; Multiply the area of the cylinder in square inches by the speed of the piston in feet per minute, and divide the product by 4,000; the quotient is the area of each steam port in square inches.

EVERY subscriber of the SCIENTIFIC AMERICAN ought to be an agent for the increase of its circulation. Whoever reads the paper can aid in this matter very materially by recommending it to his neighbors. In the absence of agents, we appeal to our friends to lend us a hand. Let us have a "subscription bee," such as we remember in our early days, when all turned out, with oxen, horses, plows, and shovels, to do up some good work with dispatch.

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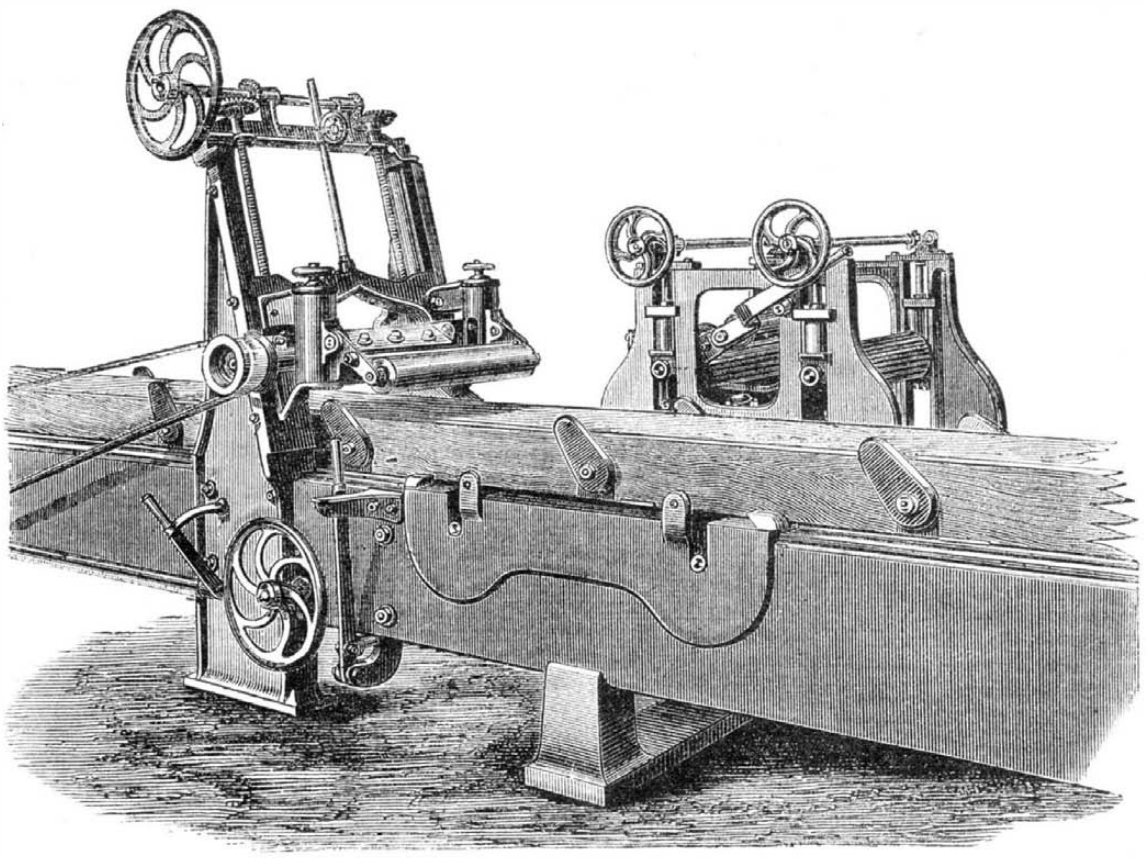
TRYING-UP AND FOUR-CUTTER PLANING AND MOLDING MACHINE.

We illustrate herewith a new wood planing and molding machine introduced by Messrs. Wm. Furness & Co., of Liverpool, Eng., for the combined purposes of dimension planing, or trying-up, and planing on all four sides timber of any length, and up to a given width and thickness. The machine is shown adapted for trying-up or planing perfectly level and out of wind a piece or pieces of timber up to 20 feet long, 20 inches wide, and 16 inches thick. This is done in the ordinary way by revolving horizontal cutters, driven by two bands, one on each side of the machine, the table with the timber traveling under the cutters at the desired rates of feed, a quick return motion being provided for bringing back the table. The novel part of the machine consists in the feed works, which are here shown to be behind the table. These feed works are formed of four calender rollers powerfully geared, between which works the bottom cutter head driven from a countershaft fixed to the framing of the machine. The side cutter heads are in advance of the second pair of feed rollers, and are also part of the feed works. One side cutter head is a fixture, and the other is worked in or out on slides by means of a screw. It will thus be seen that the feed works comprise the feed rollers and necessary driving gear, bottom and side cutter heads, and pressure rollers, etc. The whole is carried by four grooved friction rollers, running on two turned rods supported by the framework of the machine and a bracket at the back.

When it is desired to use the feed works for tonguing and grooving, molding, or planing all four sides of the timber at once (says *The Engineer*, from which we select the engraving), the table of the machine is run forward till the end is almost under the top cutter head, when the feed works can be easily drawn across the framework of the machine. It fixes itself in V slides; and the bands for bottom and side cutter heads having been placed on their respective pulleys—which are fixed on the ends of the spindles, so that no lacing or fastening is required—the machine is ready for work. It will work any size of timber up to 4 inches thick and 12 inches wide. By the removal of the side cutter heads, which is a very simple operation, surfacing or panel planing can be done by the top cutter head alone up to 20 inches wide. A very important feature of the machine is the rapidity with which the feed works can be removed when the machine is required for trying-up purposes, about five minutes being required. A great advantage, and worthy of attention, in this combination of two efficient machines is that they only occupy the same space as one machine, and only require one pulley upon the shaft of the mill to drive them.



TRYING-UP AND FOUR-CUTTER PLANING AND MOLDING MACHINE.

NEW MECHANICAL CONSTRUCTION FOR COMPOUND TOOLS.

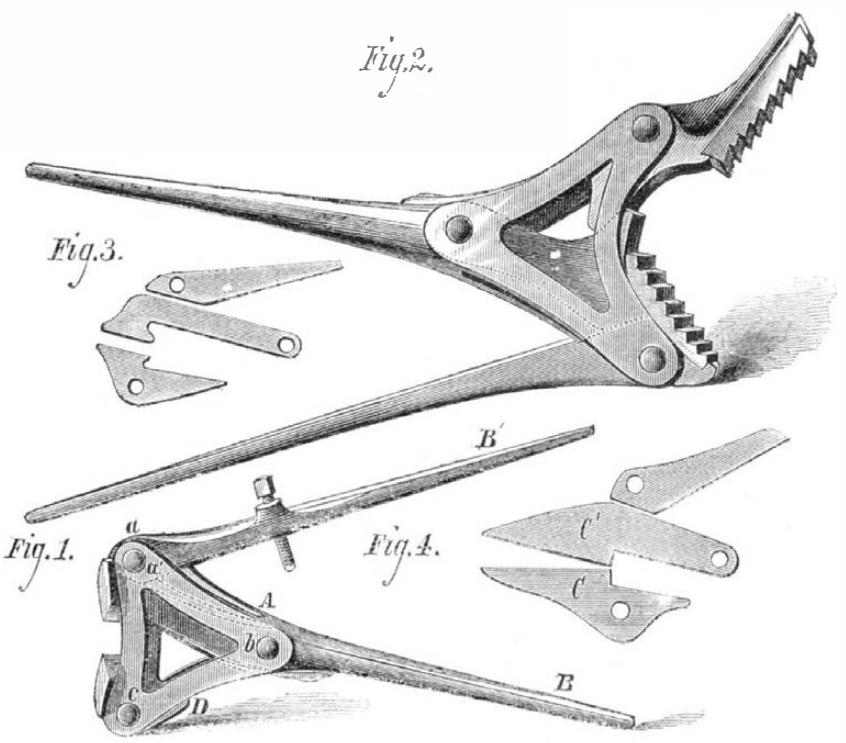
We have lately had brought to our notice an entirely novel construction for scissors, pliers, shears, and other tools of similar nature, which is an invention of considerable utility and merit, and which will doubtless commend itself as a valuable addition to the kit of every mechanic. In using implements with pivoted jaws, a large percentage of the power is wasted in useless strain on the pivot. In the present device, the pivot is abolished, and the jaws are so arranged as to be forced together by a powerful cam lever. To add to the utility of the tool, these jaws are made interchangeable, so that a single stock may answer for saw gummers, pliers, shears, saw set, pincers, and a multiplicity of other implements.

Referring to the engraving, Fig. 1, A isthe stock, B B′ the handles, C C′ the operating jaws, and D, a spring for opening the latter. The stock is recessed to form two side pieces, between which the shanks of the jaws are pivoted at *c* and *b*. The upper jaw, C′, Fig. 4, has a long shank which is recessed near its head to receive the cam, B′, which is formed on the handle, B′. The end of the shank of the under jaw, C, which is pivoted, as stated, at *c*, impinges against the shank of the upper jaw. The cam lever handle, B′, is pivoted at *a*.

When the handle, B′, is brought toward the stock handle, the cam on the former presses against the shank of the upper jaw. From this last, motion is communicated to the under jaw, so that each is made to approach the other. By reversing the handle, B′, a more powerful leverage may be brought to bear on the jaws. The cutting edges are thus forced together square and true, not overlapping so as to tear the material apart, as is frequently the case in pivoted cutting tools. There is therefore less strain on the jaws, and they are consequently more durable. A recess is provided through the jaw, C, through which bolts or wires to be cut may extend, so that a bar of any length may be divided squarely at any desired point. Each jaw is tempered separately, thereby giving to both an improved temper, unattainable in the ordinarily constructed implement. Finally, the jaws are easily adjustable, so that in case of injury they may be readily removed and others substituted, or, as above stated, tools for a different purpose may be inserted.

We are informed that, since the date of the patent of the invention, by Peter Broadbooks, of Batavia, N. Y., November 18, 1873, important adaptations of the system have been made, so as to render it suitable for the tools of over fifty classes of m echanics, including, among others, tongs, presses, bolt cutters, pruning shears, punches, pipe wrenches, and horse shoenail clinchers. The construction of the implement last mentioned is shown in Fig. 2. The arrangement of parts is the same as in Fig. 1, except that the jaws are shaped differently and are provided with serrated faces. The jaw operated by the cam lever goes under the hoof, and the angle of the latter enters the curved portion between the jaws. The corrugated face of the upper jaw, therefore, takes against the incline of the hoof, and, as it is rubbed down the same by forcing the handles together, the corrugations catch against and clinch the nails. This is done quickly and without injury to the hoof, thus saving to the animal a large amount of the suffering often caused by the usual mode of clinching.

We have tested various sizes of pliers constructed after the plan described, and find that they cut nails and spikes with great facility, one little instrument, no larger than a conductor's punch, biting off shingle nails as easily as if they were pins. The device is excellently suited for saw gummers.



BROADBOOKS COMPOUND TOOL.

The adaptation of the invention as a hand vise is shown in Fig. 3, and as a shears, in Fig. 4.

Further particulars and descriptive circulars may be obtained by addressing Messrs. S. P. Allen & Co., care of Pollock, Weaver & Co., 17 West Main street, Rochester, N. Y.

New Discoveries in the Mammoth Cave.

Professor F. W. Putnam, of the Peabody Academy of Sciences, Salem, Mass., has recently explored the Mammoth Cave in Kentucky, and has visited several caverns never before entered. His investigations have resulted in finding colored fish without eyes, thus exploding the theory hitherto held that all eyeless fish are colorless. White fish with eyes, and crayfish both with and without those organs, were obtained, presenting many new features of great interest to naturalists. Skeletons of human beings, mounds, and a large variety of valuable archæological relics were found in the new chambers.

Cheap Telegraphy.

President Orton's report of the affairs of the Western Union Telegraph Company is not calculated to inspire much hope in those who believe that the government can run the lines at cheaper rates to the public. On the 1st of January, 1873, a reduction of more than fifty per cent was made in the maximum tariff between the most remote points on the company's lines. This, though occasioning a temporary loss of revenue, has resulted, during the last few months, in a large increase. The reduction was from $7.50 and $5 to $2.50. President Orton now adds that, owing to Messrs. Edison's and Prescott's quadruplex apparatus, which is, at the present time, working successfully between Chicago and New York, and by which two messages are sent in the same direction and two more in the opposite direction simultaneously on a single wire, he believes it practicable before long to cut rates down still lower, and ultimately to establish but four rates for day messages, namely, twenty-five, fifty, seventy-five cents, and one dollar, with half charges (except for the lowest) for night messages.

Decline of City Trades' Unions.

The repeated strikes, and the suffering caused thereby to the workmen participating, are at last beginning to open the eyes of the latter to the evils of trade union rule. It appears that the unions in this city since 1873, taken as a whole, have lost fully one fifth of their members—aggregating 9,000 men. As a rule, these people have found employment, and doubtless now perceive the advantage of steady work, even at lower wages, over starving in idleness in the hope of getting ultimately a few dollars more. Some societies have suffered in a remarkable degree, notably the painters and coopers, which have lost respectively fifty and forty per cent of their members. The building trades show a decline of twenty-five per cent; the shoemakers, twenty per cent, and the cigar makers, thirty per cent. The horseshoers, tailors, hatters and longshoremen maintain their strength, though the numbers of the latter bid fair to be much depleted through the recent difficulties with the shipowners.

The Highest Lake in the United States.

Dr. Harkness has discovered, in Plumas county, California, a body of water, probably the most elevated in the United States, the barometer registering a hight of 7,330 feet above the sea level.

The lake is of triangular shape, having its longest diameter about one mile and three quarters in length. The water during last August was intensely cold and of a deep blue color. The outlet is into Warner Valley, over a declivity of some 2,000 feet. The California Academy of Sciences has named the lake, after its discoverer, Lake Harkness.

Ignorance and Crime.

We doubt if more striking evidence of the necessity of compulsory education laws and the provision of means for their rigid enforcement could be found than appears in a suggestive fact in the pages of a recent report of the National Prison Association. This volume, which is filled with copious statistics of prisons and convicts in this country, deals incidentally with the causes of crime, making its deductions from the various prison reports of the mental and social condition of the incarcerated. Ignorance is proved to be the worst evil with which a community must struggle. Forty-eight per cent of all the convicts in the United States can neither read nor write, and only one per cent of the aggregate have acquired a superior education. We trust that the enforcement of the compulsory laws already enacted in some of the States, will soon justify the wisdom that prompted them, and lead to an improvement in the average education of the lower classes.

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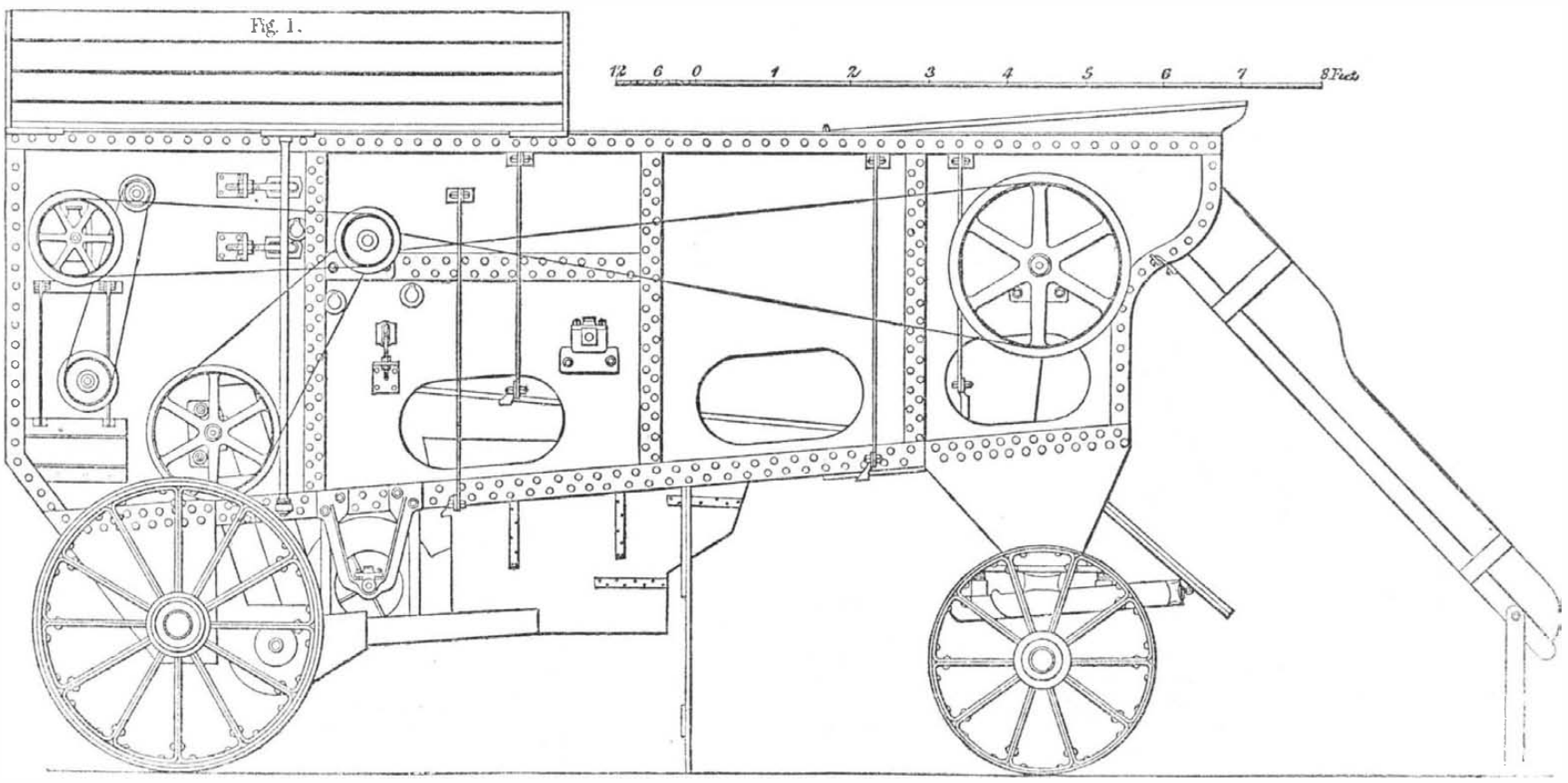
IRON-FRAMED THRASHING MACHINES.

We illustrate herewith an iron-framed thrashing machine, the manufacture of which has been made a specialty by Messrs. Marshall, Sons & Co., of Gainsborough, England, who have turned out, according to *Engineering*, a large number of these machines. Fig. 1 is a side elevation, which shows the framing, stiffened around the edges, and at intervals in the length by plates. It also shows the arrangement of the pulleys for driving the drum, shakers, fan, etc. The other view is of a longitudinal section through the center of the machine, and shows clearly the arrangement of drum, shakers, shoes, barley awners, and fan. The engravings explain the arrangement of the machine thoroughly, and we need not, therefore, attempt any detailed description, but confine ourselves to the special features of this machine, other than the iron framework mentioned above. The drum spindle is of steel, and the rings placed upon it are slotted out, as shown in our second engraving, to receive a number of iron bars, to which the beater plates are attached, this arrangement being found preferable to introducing wood beneath the beaters. The concave at the back of the drum is entirely of wrought iron. The shakers consist of four boxes, the straw platforms being arranged as shown. They are actuated by two crankshafts, one at each end, connected with the shakers by brackets. The cranks are provided with long bearings, and a collar at each end, over which the top bearing block overlaps, to keep out the dirt. The reciprocating dressing shoes are hung on spring rods, as shown, and are worked by a crankshaft similar to those for the shakers. The whole of the blast employed in the machine is taken from one fan, shown in the second engraving, one part being taken under the riddle of the main dressing shoe, and the other thrown upwards to act on the corn as it passes from the cleaner to the screen. The elevators are entirely within the machine, and lift the grain from the reservoir. We may add that a thrashing machine of this type was exhibited by Messrs. Marshall & Co., at Vienna. And we would also state that manufacturers of agricultural machines in this country would do well to take the hint from the English builders and use more metal in the construction of frames for thrashing and similar machines.



MARSHALL & CO.'S IRON-FRAMED THRASHING MACHINE.

[The Telegraphic Journal.]

ELECTRO-DEPOSITION OF METALS.

BY J. T. SPRAGUE.

[Concluded from page 393.]

The connecting wires should be secured to the objects while under water, unless, which is much better, they can be soldered on before cleaning; it is usually better to have two or three wires to an object, so as to diminish the resistance, and to shift the points of contact occasionally, in order to avoid furrows upon the face; it is better also to make the actual contact by short pieces of fine wire attached to a larger conductor not in contact with the object. The general principle to be kept in view is to make the resistance of these connecting arrangements as small as possible, and yet to avoid anything which shall interfere with the contact of the liquid and its free circulation over every part of the surface to be coated.

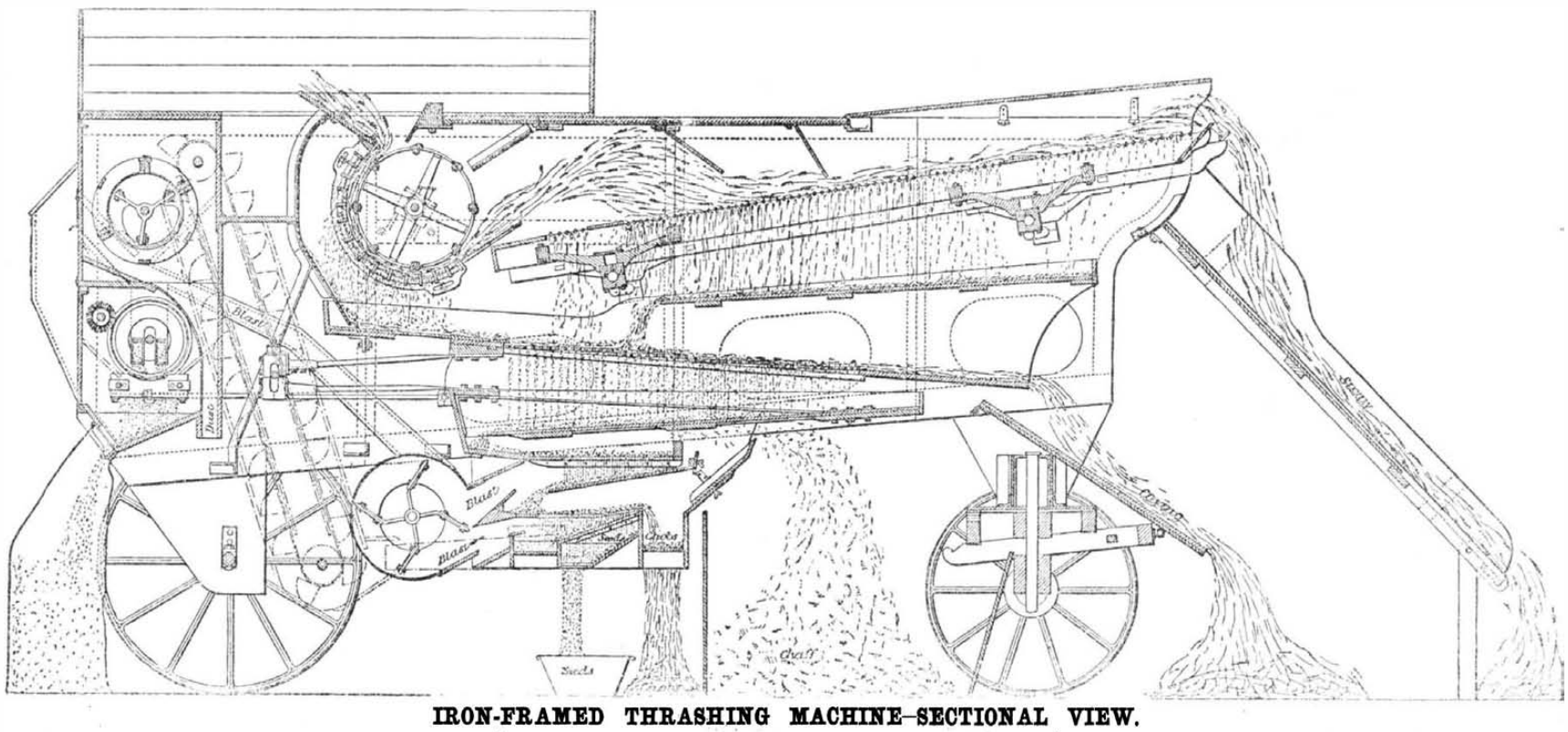
According to the conditions we set up will be the nature of the metal deposited: that is to say, its molecular condition as to cohesion, etc., will depend upon the relations of force to which the deposit is exposed. Color also depends, in great degree, upon the molecular condition of the surface; for instance, gold in very thin films has a greenish tint, owing to the light reflected through it; in a very finely divided state, as when chemically precipitated, it is a dark brown; in its ordinary condition, also, the presence of very small quantities of copper and silver greatly modifies the color. To secure deposits of good quality and appearance, therefore, it is desirable to ascertain those relations of energy which set up the conditions upon which good deposit depends.

If we pass a strong current into a weak solution of copper, the metal deposited will be pulverulent; if, by means of resistances and varying battery power, we pass a fixed current into a solution, but effect the deposit upon a surface of gradually diminished area, a series of instructive results will be obtained. If the surface is very large in proportion to the current, the deposit will form in separate crystaline granules, chiefly on the edges and corners, and a deposit formed under these circumstances will develop into a series of nodules capable of easy separation from each other. If the surface is small compared to the current, the deposit will be of a brown color, and have no coherence; this state, also, will begin to show itself first at edges and corners; there the deposit may be quite friable, while a good metal is forming at the middle of the plate. The principles of liquid conduction account for these effects by showing that the current acts in a higher degree at points and edges, just as charge does in static electricity, because at these there can be set up the most numerous lines of polarisation towards the opposing surface. We learn, in fact, that there are two sets of conditions to be attended to.

The first point is the strength of solution. If we pass a strong current in a weak solution we get the brown powder; if, without altering any other condition, we add saturated solution of the metal, the deposit may become good. In every solution there are several different ions present at the electrodes; thus, in the case in point, with a weak solution, only a small part of the cathode can have copper turned towards it; by far the greater portion of its surface must be in contact with the hydrogen of the water or acid; the conditions are, in fact.

$$\text{Cathode}\begin{cases} CuSO_4 & H_2SO_4 \\ H_2SO_4 & H_2O \\ H_2O & CuSO_4 \\ H_2O & H_2SO_4. \end{cases}$$

Now, if the current (or quantity) is larger than the Cu is equivalent to, of course H_2 is set free, and this will reduce a neighboring atom of copper, but not in contact with the electrode; that is to say, the deposit will consist of detached molecules, and most likely of a compound of copper and hydrogen. This would not occur if the current also were weak, because a weak current means a low tension at the electrode, and hydrogen can be set free only when a certain tension has been reached, sufficient to supply the requisite specific



IRON-FRAMED THRASHING MACHINE—SECTIONAL VIEW.

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energy; besides, the slow current would be able to find sufficient copper in even a very dilute solution.

It is obvious, therefore, that solutions should be sufficiently supplied with metal for all likely requirements, and the stronger they are the more rapidly they are to be worked.

The other point to be studied is the relation of the current to the solution and to the work, and this the most important, because it is under control and is constantly varying with different objects. We have seen that there is a point so near balance that the extra strength of current concentrated on the edges destroys the coherence of the deposit. Now, if we arrange several vessels in series, all alike except in the difference in the area of the cathode in each, and connect them to a battery, we can produce such a condition of things that, by the same current and from the same solution, and with the same size of anode, we shall obtain every gradation of deposit, from brown loose powder to single hard crystals. Here, then, we find a relation between the quantity, or current, and the area over which it is distributed—a relation which is rarely pointed out with the definiteness required, for this is the fundamental condition of good working. Of course this is practically known, or there could be no success in depositing, but the principle can only be understood by a distinct conception of measurement and of the molecular relations of electricity.

This relation we may examine under the name of density of current, for which also we require a unit; this is conveniently furnished by the chemic unit of current and square inch of surface. We must therefore ascertain, by experiment, for any given solution, the range of density of current which gives good work. Such an experiment is made by using a cathode of a fixed area, so that by varying the battery power we can examine the different quality of deposit produced. Having thus ascertained the rate of deposit adapted to the solution, the density of current can be controlled by similar means in actual working, so as to secure the conditions of good working and the rate and quality of deposit we desire.

CHEERFUL FOR ADVERTISERS.

The Special Edition of the SCIENTIFIC AMERICAN is being printed and mailed as fast as it can be gotten off. Orders for advertising in that edition have been so large that we have been induced to make it twenty-four pages instead of sixteen.

We hope soon to be compelled by advertisers to make every regular issue of our journal of the same size.

Those who have advertisements in the Special will be gratified to know that we shall print of our first edition—now on the press—ONE HUNDRED AND FORTY-FIVE THOUSAND copies, and it is expected that the demand will be so great that a second edition of from 25,000 to 50,000 will be required.

NEWS AGENTS will be supplied with the Special Edition by the American News Company at the same price as the regular issue; and, in ordering, they should be careful to state *Special Edition*.

DECISIONS OF THE COURTS.

United States Circuit Court.—Northern District of Ohio.

CLOVER SEED MACHINE PATENT.—JOHN C. BIRDSELL *vs.* A. MCDONALD *et al.*
JOHN C. BIRDSELL *vs.* THE ASHLAND MACHINE COMPANY *et al.*

[April term, 1874.]

SWAYNE, *J.*:

These are suits in equity founded upon certain patents issued to the complainant, touching machinery for getting out clover seed. Except in one particular, hereinafter mentioned, the bills in both cases contain the same allegations.

The parties agree as to the state of the art down to the period of the alleged inventions of the complainant.

Before that time clover heads were detached from the stems, preparatory to hulling, by the tramping of horses, by thrashing with flails, by cutting with cradles (the two first fingers being covered with canvas and the heads cut off near the place of their attachment to the stems), by removing the heads in the field by an instrument known as a stripper, and, after mowing, by ordinary thrashing machines. The heads were also sometimes detached by a machine designed especially for that purpose. Hulling out the seed was a distinct process. This was usually done by a machine used for that purpose alone. Machines for thrashing and those for hulling were frequently worked at the same time side by side.

The complainant's bill against McDonald and others is founded upon two patents, reissue No. 1,299, and the original patent, No. 35,209. The bill charges the defendants in that case with infringing all the claims, three in number, of the reissue, and the third claim of the original patent.

A patentee cannot be charged with having abandoned his invention because his solicitors, without his knowledge, neglected to file his application in the Patent Office, for more than two years after it had been sworn to, and was in all respects complete.

An invention will not be held forfeited because it was used for experimental purposes, in good faith, more than two years before applying for a patent. The objection is not one to be regarded with favor; but, if clearly established, it is fatal.

It is presumed, from the decision of the Commissioner of Patents, in granting a reissue, that it embraces the same invention as the original patent; and the contrary can be shown only by a comparison of the papers in the two cases.

A reissued patent can only be impeached for fraud by a bill in equity brought for the purpose by the Government.

A combination is legitimate when all the elements coöperate in producing a result, and are necessary to it, though their several functions are not performed simultaneously; if performed in immediate succession, it is sufficient.

If an alleged invention proves superior to what has been known before, it is evidence in favor of its novelty.

A clover machine with two hulling cylinders does not affect the validity of a subsequent patent for a machine for one cylinder for thrashing and another for hulling.

Machines which have been abandoned after being experimented upon do not prejudice a subsequent patent for a successful machine, however closely they resemble each other.

[*S. S. Fisher*, for complainant.
George Willey and *George Rix*, for defendants.]

Recent American and Foreign Patents.

Improved Sash Balance.

Newton J. Skaggs, Talladega, Ala.—By suitable construction a cord is pressed and clamped against the side bar of the sash by the downward movement of the block into the cavity of a plate. The block is raised to release the cord by means of a knob, the stem of which passes in through a vertical slot in the angle of the plate, and is screwed into the block.

Improved Running Gear for Wagons.

William H. Simmans, Memphis, Tenn.—This invention consists in connecting the reach to the front running gear by means of a tube through which the king bolt passes. The tube is secured to the axle independently, and thus relieves the king bolt of strain.

Improved Holding Jack for Wagon Bodies.

William R. Crane, Stony Creek, Mich.—This invention consists of a couple of rests for the support of a wagon body, mounted on a horizontal support, one being jointed and the other attached to it. Said support is mounted on the top of a standard, in which it is capable of turning on its axis. The standard turns on its axis, so that the box may be turned and shifted about, and presented and held in various positions for the convenience of the workmen in dressing, finishing, and painting it.

Improved Adjustable Dead Pulley.

Augustus Newell and Asa B. Cook, of Erie, Pa.; said Newell assignor to said Cook.—The loose pulley is entirely supported by the box, there being a space left around the shaft. The two arms of the double hanger are held against the sides of the box by means of a bolt, which passes through the lower extremity of the said arms. The double cam of the shifting lever, as it moves the loose pulley in and out, presses the rim of said pulley against the rim of the fast pulley, thereby causing sufficient friction between the pulleys to impart motion to the loose pulley, said motion being requisite to facilitate the shifting of the belt. A completion of the movement of the lever withdraws the pulley from contact with the other pulley, and leaves it at rest. The opposite movement of the lever applies the friction as before, shifts the belt to the loose pulley, and allows it and the belt to come to a rest.

Improved Rotary Evaporator.

Adrien Queru, Marlborough, N. Y.—The tubular arms of a revolving carrier support heating pipes, which are arranged parallel with the shaft, so that the water will flow back to the hollow hub. They are arranged also in clusters, by connecting them at each end to a hollow ring. Partitions in the hubs and hollow axle prevent the water of condensation from running back into the lower portions of the hubs; they also separate the steam on entering the pipes. The water will in this arrangement escape directly from the heating pipes by gravity, and thus offer no obstruction to the entrance of the steam; but it will not escape until the pipes rise above the horizontal plane of the axis, so that the partitions will keep it from falling to the bottom of the hubs, and will cause it to flow out at the escape side through the hollow shaft. By the separation of the hub into which the steam enters, the steam is divided and applied equally to all parts of the evaporator. The steam enters at one side, and the water escapes at the other. This apparatus is applicable to use in vacuum pans, both as a heater and agitator.

Improved Truss Bridge.

John L. Miner, Brenham, Tex.—The object of this invention is to provide a strong and cheap bridge of improved form. The stringers which are bolted to the pier caps are formed by bolting two parallel beams to each other. They are connected by two sets of zigzag braces, placed the one set at the upper part, and the other set at the lower part, of said stringers, the braces of the two sets crossing each other at their centers. The two stringers are secured to each other by tie rods having a washer and head at one end and a washer and nut at the other end, the said tie rods passing through the space between the two sets of braces. The side walls of the bridge are formed of wall plates, braces, and tie rods. The cap plate is made in three parts, the central part being parallel with the stringers, and at a distance above them of fifteen feet or more. The end parts of the cap plates are inclined, and extend to the ends of and are bolted to the said stringers. The tie rods are vertical, pass through the stringers and through the cap plates, near the upper ends of the braces, and have washers and heads upon their lower ends, and washers and nuts upon their upper ends. The girders are attached to the stringers, and, in connection with the joists, support the planks that form the road bed.

Improved Illuminating Roof Plate.

William L. Smith, Jr., P. O. Box 81, Brooklyn, N. Y.—This illuminating tile is made of malleable metal, so as to make it lighter and less liable to break than when made of cast iron. Holes are formed in a metal sheet with collars in it of a size to suit the glass. Another sheet is added, in which holes are made of a size to prevent the glass from falling through, thus forming seats for the glass to rest upon. The holes in the two sheets are punched, so as to correspond with each other in position, and the two sheets are fastened together.

Improved Hoe.

William Moore Faunt Le Roy, Fredericksburg, Va.—This invention consists in making the handle adjustable with regard to the blade to suit the various purposes for which hoes of various kinds, as well as shovels, are used.

Improved Wagon Jack.

Frank Judson, Des Arc, Ark.—For operating the jack, a lever is raised as far as it will allow, and a catch is placed as far out on the rack of the lever as possible. The lever is then pressed downward to raise the center post. A pin is placed through the lowest visible hole above the upper part of the standard for sustaining the weight thereon, and the operation of raising the center post is then repeated until the wagon or other object to be hoisted is at the required hight.

Cutting Block Holder for Leather Workers.

Elias P. Newton and Hiram A. Titus, Gloversville, N. Y.—This cutting block holder has adjustable ends provided with pendent extensions and connected by screw rods at top and bottom to provide for longitudinal adjustment.

Improved Weighing Scales.

Henry M. Weaver, Mansfield, O.—These weighing scales may be so adjusted that the net weight of any article placed on the platform may be directly read off at the dial plate. By the position of the weight, a portion of the same is thrown above a horizontal line drawn to connect the pivoted points or edges of swinging bars, so that, by rising above the line, it proportionally loses its power as a counter weight, and causes a pointer to describe equal distances, on a dial plate, when equally increased weights are placed upon the platform.

Improved Grate.

Jonathan Moore, Jr., Brooklyn, N. Y., assignor to himself and Lorenzo D. Longhi, same place.—The bottom portion of the grate is made in two parts, one being a door to which the other part is a frame. A button on the under side of the frame swings under the door and holds it up. The grate can be opened for cleaning it out without the aid of a lever, the button being readily turned by the fire hook, shovel, or any instrument. The hinges are protected from the ashes and cinders.

Improved Horse Detacher.

Anatole Ehret, Telegraph City, Cal.—The traces have loops by which they are hitched to hinged bolts at the ends of the singletrees. A spring catch is thrown by a spring in front of the hinged bolt, to hold the bolt in position for confining the trace. The spring catches are connected with sway bars by chains. When a lever is pushed outward, the effect is to draw back the spring catches, which detaches the traces from the singletrees.

Improved Soldering Machine.

William D. Brooks, Baltimore, Md.—This invention relates to that class of soldering machines which inject a flame upon can joints, so as to melt the solder and allow it to be uniformly disseminated along the seam, whether it be in soldering the cap, top, or side seam. The invention consists in providing, on a burner end or gas outlet of the compound blowpipe, a continuous slot or opening, so that all parts of the seam may simultaneously receive the same quantum of heat and its due proportion of solder, a perfect and reliable joint being thus always formed.

Improved Gate Hinge.

Stephen G. Peabody, Champaign, Ill., assignor to himself and Lymar D. Chaddon, same place.—This is a hinge for gates, heavy doors, etc., so constructed as to prevent water from entering about the pintle, and also self-closing. Concentric cups are formed upon the adjacent ends of the parts of the hinge. In one cup is placed a coiled spring, which causes the hinge to close itself when released.

Improved Apparatus for Making Extracts.

Julius Robert, Gross Selowitz, Austria, assignor to Otto Kratz and R. Sieg, New Orleans, La.—This is an improved arrangement of extractors in a single battery, together with conducting and connecting pipes and heaters, for making extracts of juice from plants, by the process of diffusion, as described in the patent granted to the same inventor, October 30, 1866. The plants are first cut into thin slices and placed in extractors, together with water, and allowed to stand for a short time, when the juice is replaced by other juices of less strength than the remaining juice in the cells of the plants, and so on, until all the juice is extracted. The thick juice is drawn off to the factory, for the subsequent treatment, while the thin juices are passed through the heaters for being warmed, to be used for other diffusions, until made thick enough to be conducted away. By suitable arrangement of pipes and connections, the operation is carried on continuously and in succession in all the different stages without interference of one with another.

Improved Guide Wheel for Car Trucks.

Nathan M. Hale, Cleburne, Texas.—This invention consists in supporting horizontal wheels that run under the flanges of a central T rail on springs, the elasticity of which allows the wheels to rise and pass any obstacle without stopping the car or injuring the track. This allows the wheels to be fastened to the cow catcher, and renders unnecessary the elevation of the main rails to an equality with the central one.

Improved Double Cultivator.

James M. Holladay, Twyman's Store, Va.—This invention relates to certain improvements in double cultivators. It consists in the peculiar construction of devices for adjusting the tongue or pole from the rear for the purpose of adapting the implement to hillside cultivation, and also in the peculiar construction and arrangement of the parts of a traction frame, so jointed and attached to the carriage as to admit of the cultivator proper being lifted from the ground and suspended about the axle for the purpose of transportation. It consists, further, in the manner of pivoting the traction frames so as to adjust the cultivator laterally to the irregularities of the row, and to deep or shallow cultivation.

Improved Paint Brush.

Etienne X. Thiercelin, Shark River, N. J.—This invention consists of a tapering handle with metallic socket, connected by guide strips or prongs of the same with the top and side part of the outer bristle binding socket, after the handle has been carried centrally through the bristles to strengthen it and make it more durable.

Machine for Smoothing and Cornering Panels.

Jacob P. Beck and John H. Weaver, Lock Haven, Pa., assignors of one third their right to A. N. Raub, same place.—This is an improved machine for smoothing and cornering panels, so that the sandpapering of the raised part at one side thereof may be obtained, at the same time with the broad level portion at the other side, by mechanical means in place of by hand work. There are vertically rotating heads, with detachably inserted pads, covered with sand paper for smoothing both sides of the panel, and adjustable detachable bits for cornering the same. The revolving heads work on separate mandrels, one being laterally adjustable to the thickness of the panel, and the other being capable of vertical adjustment on an arc-shaped guide support.

Improved Machine for Driving Brush Handles.

John Ames, Jr., Lansingburgh, N. Y.—In this machine devices are provided for driving all the brush handles of the same lot to exactly the same point. The ferrule of the brush is held and supported while the handle is being driven. By means of weighted cords a tube is forced up through the brush head. Within the tube is placed a rod, the upper end of which is pointed so as to open a way for the said tube through the brush head. The rod is supported in the tube by a coiled spring. The tube and rod moves upward through the brush head, and strikes against a stop. This leaves the upper end of the cavity of the tube empty to receive the point of the brush handle, the other end of which rests against the lower end of the driver. The driver is then forced downward by operating a hand wheel, which forces the brush handle through the brush head. As the point of the brush handle passes down through the brush head and through the table, it is received in the concaved upper end of a short tube, through which the other tube passes, and all the parts are carried down together by the continued descent of the handle. By suitable arrangement, when the brush has been removed and another brush head arranged in the thimble, a slight pressure with the operator's foot upon the end of a bent lever will release the tube, and allow it and the pointed rod to be forced up through the brush head by the weights.

Improved Knob Spindle Fastener.

Eugene F. Lincoln, Boston, Mass., assignor to himself and John C. Hancock, same place.—This invention consists of a little slide bolt inside of the rose plate, to lock the knob spindle by sliding into a notch in the edge of a disk on the spindle. The said slide has a pawl with a handle pivoted to it, so as to drop into the slot of the escutcheon plate, through which it projects, to lock the bolt when shoved forward. There is also a spring for throwing it back when the pawl is pulled out of the slot to release the slide bolt. The object is to provide a simple inside lock for fastening the door of water and other closets, sleeping rooms, etc., temporarily, without having to change the key from one side of the door to the other.

Improved Seedlings Puller.

John S. Swaney, Marengo, Iowa.—As the machine is drawn forward, the jaws are opened to allow the plants to pass between them, and to grasp the said plants and draw their roots from the ground. As the jaws are again opened by the opener, the plants will drop into a concavity formed in the frame, whence they are taken by an attendant and bound. As the plants pass up at the rear side of a wheel, they are struck by a horizontal rod which has a rapid up and down movement. By this device all the soil is knocked off the roots of the plants before they are dropped into the receiver.

Improved Machine for Rubbing Oil Cloths.

Charles Rommel and William H. Crane, Elizabeth, N. J., assignors to themselves and Wisner H. Townsend.—This invention consists of a reciprocating rubber, to which simultaneous revolving motion is imparted by its connection with a shaft with cranks arranged in opposite direction. The rubber frame supports the pumicestone blocks on a sliding interior frame, which is hung to a roller with handle, to be readily raised with the pumicestones, for admitting the cloth below the same.

Improved Car Axle Box Support.

Charles Billmeyer, York, Pa.—This invention relates to that class of trucks which are intended for narrow gage roads, and which are let down, as respects the axle boxes and the load, so as to prevent the center of gravity, on a tilt, from passing outside the rails and thus overturning the cars.

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Spinning Rings of a Superior Quality—Whitinsville Spinning Ring Co., Whitinsville, Mass. Send for sample and price list.

H. K. will find a recipe for cement for grindstones on p. 251, vol. 31.—J. H. B. will find a recipe for hard cement on p. 9, vol. 379, and a description of porcelain on p. 3, vol. 30.—F. W. D. will find an explanation of the shirt polish mystery on p. 203, vol. 31.—F. H. M. will find a recipe for a silver plating solution on p. 299, vol. 31.—J. F. will find that a process of tempering mill picks is detailed on p. 202, vol. 31.—G. R. L. C. will find directions for mounting chromos on p. 91, vol. 31.—C. H. F. will find directions for preserving iron from rust on p. 299, vol. 31; for painting brick walls on p. 346, vol. 31.—W. H. M. can clean chamois skins by the process detailed on p. 91, vol. 31.—W. H. K. will find a description of the cultivation of the castor bean on p. 335, vol. 31.

(1) J. S. S. says: I contend that if two casks are put on an equal level, and a one inch pipe is fastened airtight in the head of one end, and a 12 inch pipe similarly in the other, each pipe being 50 feet high and filled with water, the pressure will be as much in one disk as the other. Is this so? A. The pressure on equal and similar areas in the two casks will be the same.

(2) J. C. asks: Can you tell what to put on albumenized paper to remove the gloss, so that water colors can remain on the surface? A. Try gentle steaming.

(3) G. V. says: I intend to pump water for irrigation. I have to carry the water 600 feet in an open tank or trough, the amount of water to be pumped being 1,000 gallons per minute. I can afford to give it a fall of 3 inches in the whole. What should be the dimensions of the trunk? A. Give the trunk from 1½ to 2 times the cross section of the discharge pipe of the pump. 2. Would pine lumber 1 inch thick be heavy enough? A. Yes.

(4) D. J. T. asks: 1. What percentage of boiler pressure is the mean effective pressure on piston in an ordinary slide valve engine with throttle valve wide open? A. From 75 to 80 per cent. 2. I have been running for eighteen months an engine with 10x16 inches cylinder, and I notice that some of the bolts that hold the face plate to steam chest, also to cylinder head and piston head cap, are being cut away as if by acid; some of them are reduced to about one half their original size. The part affected is that which passes through the steam chest plate, the piston head cap, and the cylinder head. It is not rust, for the parts have been kept perfectly well lubricated. Can you tell me the cause and a remedy? A. Probably caused by water carried over with the steam, in which case the use of dry steam will be a preventive.

How can I make a first class Babbitt metal? A. You will have to experiment to get the metal right. See p. 364, vol. 29.

(5) E. P. asks: What process is used in casting steel or iron into ingots, so as to prevent blow holes on the outer surface? The process I have used is casting through a sprue into bottom of mold, causing metal to flow upward. This process is not satisfactory, and I wish to know how it can be remedied. A. Make your mold with a long neck, into which the air may rise and leave the blowholes in the top part of the casting, which is to be cut off.

(6) J. A. T. asks: I desire to construct a reflector telescope. 1. Can ground specula be procured in this country, 4½ or 6½ inches in diameter? A. Yes. 2. What would be the probable cost of a 4½ or 6½ inch speculum? A. For silvered glass mirrors, parabolized, $10 for each square decimeter (4 inches) of surface. The focus is six times the diameter, and the highest power equals twice the aperture expressed in millimeters (fifty per inch). 3. Could you give me a full explanation of the construction of small sized reflectors? A. The English have devoted much talent and money to the construction of reflectors without adequate results. The diagonal plane of the Newtonian obstructs the best part of the mirror, and its supports add diffraction wings to the image of a star. Still the silvered mirror costs but one fifth, and its power is nearly five sixths, of that of the achromatic of like aperture.

(7) C. asks: Does a fence over a hill contain exactly as many pickets as a fence on level ground, between the same points, the pickets being the same distance apart? A. Yes.

(8) M. asks: What do opticians mean by immersion lenses? A. An immersion lens is a microscopic objective which has its front and back combinations so adjusted that a film of water, joining the front surface and the thin glass cover of the object, completes the correction for spherical aberration, which correction depends in a dry objective upon the thickness of the front lens. Objectives of 1-10 inch and shorter focus are made to work either dry or with immersion by a screw collar adjustment.

(9) Z. T. K. asks: What is the horse power of an undershot or current water wheel 30 feet in diameter, of 15 feet face and 3 feet deep, running in a current which moves 3 miles an hour? A. Multiply 0·384 times the square of the velocity of the water in feet per second, and divide by 35,420. As to your other query, see article on friction of water in pipes, p. 48, vol. 29.

(10) T. C. W says: I melted 1 lb. resin and 1 lb. pitch together, in an iron vessel; then, while hot, I poured the contents of the vessel into a wooden mold, in the shape of a brick. But I found. after the mixture got cold and hard, that I could not get it out of the mold; it adhered to the wood. Please to tell me how to construct a mold so that the substance will readily come out when cold and not adhere to the mold. A. Try coating the mold with paraffin.

(11) M. H. P. says: We use in our kerosene lamps a powder which prevents breaking of chimneys. It is said to destroy the naphtha. Can you inform me of any ingredients that will answer the above purpose? A. You do not state the mode of applying the powder in question. If you will send us a sample of the powder and a description of the mode of application, we will endeavor to answer your question.

Is there a cement for mending cracks in iron pots? A. Try glycerin and litharge.

(12) E. C. H. asks: What ingredient in soap is it that, when coming in contact with the eyes or an abrasion of the skin, causes it to smart? A. The alkali it contains. 2. Can there be manufactured an effective article of soap that will not cause such pain? A. No.

Which would be the most serviceable application for ordinary New Jersey yellow pine weather boarding, lime, whitewash, or coal tar, and which would be the coolest in hot weather? A. The whitewash.

(13) S. H. T. asks: What is the mode of etching engravings, etc., on glass? A. See our answer to P. M., No. 4, p. 298, vol. 31. The printing ink protects the glass with which it is in contact from the corroding action of the acid. Mr. Napier, the patentee, prefers to have the glass ground enameled or veneered beforehand, when the objects stand out in relief. If the veneer or enamel is colored, of course the picture remains colored, while the body of the glass is white. This also answers J. G. G.

(14) J. H. asks: How much more power, if any, will be required to turn a wheel one foot in diameter four times around than to turn a wheel 4 feet in diameter once round in the same time? A. Multiply the resistance by the distance through which it is overcome in each case, which will give you measures of the power exerted in turning the two wheels.

(15) J. C. D. says: I wish to run my sewing machine by water power, and propose the following plan: A water wheel 15 inches in diameter, inclosed in a watertight case, to be adjusted under the table of the machine, with a tank, resting 20 feet above the floor and 30 feet on a horizontal line. The tank to hold about 200 gallons, with a pipe leading to the wheel 1½ inches in diameter. The jet from this pipe to be ¼ inch in diameter, and strike the water wheel at about 45° below the line of the shaft; a discharge pipe to be adjusted at the bottom of the wheel case. Will this run the machine for ordinary domestic sewing? A. This plan will doubtless answer well.

(16) W. H. G. asks: If a loaded ship, afloat, were elevated one half the number of feet which it draws, would it capsize? A. Generally it would; but the load might be so disposed that the ship would remain upright.

(17) A. M. asks: By what process are raisins manufactured? Can the grapes grown in this part of the world be used for this purpose? B. The grapes are dried, either in the sun or in ovens. We do not think it likely that raisins made from the grapes of this country would compare very favorably with those that are imported. We cannot refer you to any work especially devoted to this subject.

(18) J. N. & S. say: We want to drive a shaft at a right angle to our line shaft, and wish to know if we can do it with friction pulleys. The speed of line shaft is 300 per minute. Of what material and how should the pulleys be constructed? A. You can do it with friction pulleys, made of cast iron, if you have sufficient surface.

(19) M. F. D. asks: 1. How shall I make a dry rose madder suitable for painting on wax for flowers? A. Inclose 2 ozs. troy of the finest Dutch madder in a bag of fine and strong calico, large enough to hold three or four times as much. Put it into a marble or porcelain mortar, and pour on to it a pint of clear soft cold water. Press the bag in every direction, and pound and rub it about with the pestle, as much as can be done without tearing it, and when the water is loaded with color pour it off. Repeat the process until the water comes off but slightly tinged, for which about 5 pints will be sufficient. Heat all the liquor in an earthen vessel till it is near boiling, and then pour it into a large basin, into which place 1 oz. of pulverized alum; stir the mixture for a short time, and while stirring pour in gently about 1½ ozs. of a saturated solution of subcarbonate of potash; let it stand till cold, to settle; pour off the clear yellow liquor, add to the precipitate a quart of boiling water, stirring it well; and when cold separate by filtration the lake, which should weigh ½ an oz. Fresh madder root is superior to the dry. 2. How shall I make cadmium yellow for the same purpose? A. Cadmium yellow (sulphide of cadmium) is a compound of sulphur and cadmium. It is obtained by precipitation from a salt of cadmium by a current of sulphuretted hydrogen gas, or by an alkaline carbonate.

(20) J. N. P. says: The copper mines in the mountains of East Tennessee are second to very few in the country. I recently observed a precipitating process which interested me very much. Two shafts have been sunk to a depth of fifty or sixty feet, and a stream of so-called "copper water" has been struck. Pumps are inserted, and this water is pumped into a very long trough, running nearly level. Into this trough is put a lot of old scrap iron. Every twenty or thirty feet along the trough are pits, about two feet deep, into which the precipitated copper is swept. It is then shoveled out and is ready for the refinery. 1. Of what does this water consist? What is the proper name of it? A. A solution of sulphate of copper in water, and probably proceeds from the oxidation of copper pyrites (sulphide of copper). This solution is commonly called blue vitriol. 2. If the residue is the copper precipitated from the water, what becomes of the iron? A. The iron takes the place of the copper in solution. 3. What is the proper name of the water after the copper is taken out? A. The solution of sulphate of iron is called green vitriol.

In certain parts of the country adjacent to the mines, there prevails among the cattle a disease which the natives call milk sickness; they say the cattle never have it unless they have been feeding in dark caves or places in the mountains where the sun seldom shines. To what is it attributable? A. Probably to some poisonous substance contained in the water, which could be determined by an analysis.

(21) W. S. B. asks: 1. Has science ever given a decided answer as to the cause of the Gulf Stream? A. It is due to the flow of the heated waters of the torrid zone towards the poles, the direction of the flow being influenced by the earth's rotation and the forms of the continents. 2. How swiftly does it flow, and how wide is its current? A. The maximum velocity of the Gulf Stream is five miles an hour, and the average less than one and a half.

(22) J. W. asks: 1. Does lead contain sulphuric vapors and oxygen vapors? A. No. 2. When lead melts, does it expand and force the vapors off? A. No. 3. When the lead is cooling, does it reabsorb these vapors from the air? A. No.

1. Is there such a thing as malleable glass? A. No. 2. Fluorhydric acid corrodes glass. Is the glass converted into a vapor or into silicic acid? A. It attacks the silicic acid in the glass, combining with it to form hydrofluo-silicic acid. 3. Can the glass be obtained by evaporating the fluorhydric acid? A. No.

Do potassium and magnesium combine together? A. No.

If four grains of arsenic and two grains of potassium were combined together, would the combination be green? A. No.

(23) P. E. V., of Paris, France, asks: 1. Will you please give more precise details for preparing the waterproof paper described on p. 146, vol. 31? I have tried the process, but failed. A. A concentrated solution of borax in warm water should be made, to which is added the shellac in a fine powder. The paper, after saturation in the solution, may be pressed between rubber rollers and dried. 2. What is aqueous solution of shellac in borax? A. Shellac is the purified resin which exudes from the branches of several trees in tropical climates, and in particular from the *ficus indica*, *ficus religiosa*, and *rhamnus jujuba*. It is soluble in an aqueous solution of borax, by which it may be distinguished from most common resins.

(24) C. B. F. asks: What is the thickness of the earth's outer crust? A. Nothing is definitely known as to this. Some philosophers fix 60 miles as the thickness of the earth's crust, and others imagine it to be 125.

Should cream be allowed to sour before churning? A. No.

1. Is silver better than brass or German silver for a cornet? A. There is some difference of opinion on this subject, but the general belief is that there is no particular advantage in employing silver. 2. What is German silver composed of? A. Copper, zinc, and nickel.

Is gold the heaviest metal? A. No.

Is the centennial tower progressing? A. You should apply to the projectors for information. We have heard nothing of it, late.

(25) C. E. W. asks: What is the rule for finding the mean of the thermometer when part of the observation are above and a part below zero? A. Add all the negative readings together, and subtract the sum from the sum of the positive readings. Divide the difference by the whole number of readings.

(26) S. K. H. asks: What is oxygenized oil, used for testing olive oil? A. Several oils have the property of absorbing oxygen under certain conditions, among which is boiled linseed oil. This latter may be possibly the oil in question; but no mention can be found, in scientific works, of any oil specifically named oxygenized.

(27) R. S. asks: What is the gas or smell proceeding from newly baked bread? My dwelling is connected with a bake house, and the smell from a large quantity is penetrating, and very disagreeable. Is it unhealthy? A. The smell is due to the escape of the gases and volatile compounds generated from the breadstuff during the process of fermentation, and expelled by the heat. We know of no case where it has proved unwholesome to a marked degree.

How can I determine whether water is poisoned by passing through lead pipe? A. Render the water acid with dilute oil of vitriol, and add sulphuretted hydrogen to it. A black coloration indicates the presence of lead.

When plaster of Paris has been used to fasten the parts of a lamp together, what will soften it so that the parts can be separated? A. Dilute muriatic acid.

(28) N. E. L. says, in reply to Y. M., who has trouble in sucking water with his pump at 200 revolutions: I am using a small engine, and I was told I could not suck water from a well about 20 feet deep with ¾ inch pipe. I put in the pipe; and near the pump in the suction pipe, I put a T joint with about 1 foot of ¾ pipe, with the end soldered up. This serves as a water or air chamber. I have no trouble in running 200 revolutions per minute. J. M. should put in an air chamber about five times the capacity of his pump. A T joint and a piece of pipe may do, but an air chamber, with the water drawn from the bottom and the supply pipe coming in a few inches above, so that, while it is pumping, it will not prevent a steady flow of water into the chamber, will be better. The pump now has to start the water in the whole length of the supply pipe; and in fact, the pump will form a vacuum before the momentum of the water is overcome. With an air chamber, it has only the water from the pump to the air chamber to start.

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and the water flows into the air chamber in a steady stream. J. M. may not be able to run at 200, but I think he can go over that. I think the supply pipe is large enough. I hope J. M. will tell through your paper how he succeeds. A. Your hints are practical, and will be of great value to some readers. The air chamber in the supply pipe, however, is not the universal panacea for sulky pumps that you seem to consider it. Still, no one who puts in such an air chamber will have cause to rerget it.

(29) E. L. F. says, in reply to F. S. M. & Co.'s query as to sesquioxide of manganese: The sesquioxide of manganese is found in its anhydrous state as braunite, and in an hydrated state as manganite. It may be obtained by passing chlorine through manganous carbonate, placed in water, and afterwards applying diluted nitric acid to remove the excess of the carbonate.

(30) E. L. F. says, in reply to W. H. R., who asked how to make the muriatic salts of nickel: Pure nickel has a great similarity to iron, both in its external appearance and its combinations, and is regarded as a tetrad, although it forms but one chloride, in which it is bivalent. Nickel chloride (Ni Cl_2) may be prepared by dissolving the oxide or carbonate of nickel in hydrochloric acid. By a simple process, the nickel carbonate may be prepared from the crude *speiss*. Any good work on chemistry explains the method.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Vegetable Fibers. By J. W.
On Hydrocarbons of Iron and Steel. By L. P.
On Solids Floating on Liquids. By A. R.
On Popular Dental Science. By C. S. S.
On a Flying Machine. By C. H. C.
On Boiler Explosions. By R. B.
On Oyster Culture. By O. C.
On Suet Butter. By J. L.
On a New Projectile. By W. L. A.

Also enquiries and answers from the following:

J. G. G.—S. W. R.—E. W. H.—C. A. P.—X. Y. Z.—L. N. K.—W. J. R.—J. W. D.—W. D. D.—F. R. D.—M. L. W.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of enquiries analogous to the following are sent: "Who erects wire tramways? Who buys broken window glass? Who builds engines and boilers for small boats? Where can spectroscopic apparatus be bought? Who sells photographic chemicals that can be relied on for quick work?" All such personal enquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week ending

November 24, 1874,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

Alarm, grist, Hashon & Wright 157,174
Alphabet case, Baade & Sangster 157,113
Bale tie, S. J. Leach 157,206
Bale tie, J. L. Reese 157,223
Bee hive, P. O. Peterson 157,108
Beer faucet ventilator, H. Gnosill 157,172
Beer with gas, charging, J. C. Kennedy 157,181
Bit stock, J. S. Mitchell 157,212
Blind, folding, A. Le Roy 157,075
Boiler, J. R. Lamb 157,184
Boiler, steam, S. Bickerstaff 157,114
Boilers, injector for steam, W. Randall 157,105
Boiler water circulator, N. Wiard 157,256
Bolting machine, Martin & Lytle 157,209
Brick mold, J. Treadway 157,247
Broom hanger, G. Yinger 157,263
Brush, A. Thomson 157,244
Brush, shoe, C. O. & I. N. Kelly 157,180
Brush trimming machine, J. Pickering 157,104
Buggy seat, J. B. Wells 157,144
Bullet, patched, F. O. Scholze 157,227
Bung and faucet, closing, Darozir *et al* 157,092
Butter salting scales, A. A. Skinner 157,233
Can, sprinkling, J. W. Gesaman 157,170
Car brake, hydraulic, W. M. Henderson 157,175
Car coupling, H. C. Chapman 157,193
Car coupling, D. W. Deal 157,093
Car coupling, L. Dill 157,066
Car coupling, B. R. Webber 157,253
Car, safety, H. B. Myer 157,077
Carriage top support, Z. C. Brown 157,151
Chair, adjustable reclining, A. Rapp 157,081
Chopper, meat, Edwards & Morlan 157,164
Chopper, meat, A. Nittinger, Jr 157,213
Clock keys, manufacture of, G. D. Clark 157,064
Clocks, spring barrel for, G. H. Blakesley 157,088
Clothes mangle, W. Tinsley 157,245
Clothes wringing machine, M. & F. Way 157,252
Clutch, friction, Burwell & Bates 157,063
Coffee, cooling, J. Burns (r) 6,144
Cooler, milk, R. Smith 157,138
Copies, producing facsimile, E. De Zuccato 157,161
Corn coverer and cultivator, J. Copeland 157,196
Corset, J. Bowers (r) 6,143
Cradle, L. H. Stellmann 157,141
Cranberry picker, W. Crowell 157,158
Cross head gib, W. A. Rideout 157,136
Cultivator, Graham & Wallace 157,125
Dental amalgam, S. S. Southworth 157,140
Derrick, C. Lidren 157,207
Dividers, W. Smith 157,137
Door, sash, L. W. Tatum 157,085
Doors, rail for sliding, J. D. Skeer 157,235
Draw frame stop, D. W. Hayden (r) 6,147
Draw frame stop, A. A. Sweet 157,142
Dredging machine, R. R. Osgood 157,101
Drill for drilling metal, hand, D. D. Mackay 157,099
Drill, rock, C. S. Pattison 157,133
Elevator, H. H. Blake 157,061
Elevator, bucket, H. Port 157,135
Elevator, hydraulic, A. Granville 157,126
Engine crank, W. M. Boggs 157,147
Envelope, A. C. Fletcher 157,167
Explosive compound, C. W. Volney 157,143
Faucet, tool for finishing, H. Soffe 157,139
Feather renovator, J. C. West 157,255
Fence, portable, J. M. Overpeck 157,214
Fence, wire, J. F. Glidden 157,124
Fire escape, J. B. De Boucherville 157,065
Fire extinguisher, T. D. Pennington 157,217
Fire extinguisher, chemical, Holzner & Lauer 157,177
Food, preserving, D. Snedeker 157,107
Fork, hook, shovel, and hoe, G. H. Perkins 157,219
Fruit protector, A. S. Dykman 157,499
Fulling machine, C. Ackerman 157,086
Game apparatus, W. C. Wingfield 157,259
Glassware, stemmed, J. Oesterling (r) 6,151
Grain drill, W. Henigst 157,072
Grate bar, A. F. Crowell 157,091
Halter, pastern, J. C. Ford 157,122
Harness, A. W. Lawton 157,074
Harness attachment, J. D. Truss 157,248
Harness saddle, F. W. Maldeis 157,208
Harvester, A. Gray 157,127
Harvester cutter, G. Sweet 157,243
Harvester knives, grinding, E. W. Phelps 157,079
Harvester rake, Peckenpaugh & Miller 157,216
Heel shave, M. A. Tyler 157,110
Hemp brake, T. Jones 157,096
Hook, detaching, Stone and Mansfield 157,084
Horseshoe, J. Jorey 157,179
Indexing wheel, H. H. Edwards 157,163
Indicator, low water, R. R. Carpenter 157,118
Ironing board, A. H. Swain 157,242
Jack, lifting, D. T. Welch 157,254
Kiln, brick, W. S. Colwell 157,090
Ladder, step, Brown & Sweet 157,188
Ladder, step, T. F. Kiff 157,183
Lamp lighting apparatus, M. A. Lynch 157,098
Latch, locking, J. W. Williamson 157,257
Leather, scrubbing and cleaning, S. Branaugh 157,149
Lines, taking up slack of, H. Douglas 157,197
Liquid measure, S. C. Redgrave 157,222
Locomotive exhaust mechanism, A. O. Denio 157,160
Lubricating compound, W. C. Tilton 157,108
Lubricating cup, J. E. Lonergan 157,076
Lubricator, spindle, Stauts & Rigby 157,240
Mills, conductor for rolling, J. Gearing (r) 6,149
Nozzle, exhaust, G. Sewell 157,231
Nozzle for steam cylinders, G. Sewell 157,230
Packing of condenser tube, etc., W. A. Lighthall 157,097
Padlock, permutation, J. L. Willbur 157,258
Paint, fireproof, J. C. Smith 157,083
Paper pulp, filling fiber in, H. Duemling 157,198
Paper with emery, etc., coating, R. J. Edwards 157,068
Pawl and ratchet, J. Corbett (r) 6,146
Peg cutter, A. Whittemore 157,145
Pen and pencil case, C. H. Downes 157,067
Philosophical estimator, F. M. Stapff 157,239
Pianoforte metal frame, J. E. Atwood 157,187
Pipe, water, J. A. Calantarients 157,190
Plane, bench, Duncan & Talbot 157,162
Plane handle, F. Goodnow 157,069
Planter, corn, S. Wright 157,262
Plow, A. B. Kellogg 157,204
Plow, A. Smith 157,234
Plow, side hill, M. Ellis 157,200
Plow, side hill, L. L. Iverson 157,130
Plow, sulky, E. Derwent, Jr 157,119
Polishing machine, W. S. Wood 157,261
Pottery spring punch, A. H. Hews 157,129
Press, H. K. Burnett 157,089
Press, cotton, W. Koehl 157,205
Press, cotton, J. C. Stokes 157,241
Press, cotton, W. H. Walker 157,251
Pulley, expanding, C. A. Brand 157,150
Pump bucket, chain, S. C. Hamlin 157,173
Pump, plenum and vacuum, D. L. Cameron 157,191
Punch, registering ticket, J. Corbett (r) 6,145
Purifier, middlings, A. Fulton 157,169
Raft, life, C. Parker 157,215
Railroad crossing gate, O. Gassett 157,123
Railroad, elevated, J. M. Hannahs (r) 6,150
Railroad gage, J. T. Ketchledge 157,182
Railroad rail joint, Bryson & Pugh 157,152
Rake, horse hay, J. D. Jones 6,154
Regulator, exhaust, C. C. Gregory 157,201
Retort cap cover, P. Munzinger 157,100
Rivet, M. Bray 157,116
Rolling iron straps, machine for, J. Jensen 157,131
Roof truss, U. G. Spofford 157,238
Roofs, metallic cap for, P. B. Laidlaw 157,132
Sash dovetailing machine, Pennell & Zimmer 157,134
Sash fastener, W. C. Alden 157,186
Saw mill dog, G. W. Baker 157,146
Saw mill dog, J. A. Fordon 157,168
Saw mill dog, L. P. Gilbert 157,171
Saw mill dog, N. Hunt 157,202
Saw tooth swage, A. G. Rouse 157,225
Scaffold clamp, W. Smith 157,236
Screw driver, I. Allard 157,087
Screw driver, W. F. Patterson 157,102
Seeder, plaster sower, and harrow, L. Dague 157,159
Seeding machine, A. C. Evans 157,166
Separator, ore, Campfield & Hornbeck 157,192
Sewing machine attachment holder, J. H. Bean 157,059
Sewing machine ruffler, L. Schultz 157,228
Sewing machine table, E. R. Adams 157,185
Sheep shearing devices, E. Chaquette 157,156, 157,157
Shutter and window fastener, J. C. Ryckman 157,226
Sieve, metallic, C. B. Porter 157,220
Sleeve adjuster, A. Perego 157,218
Snow plow, hand, C. A. and G. R. Parker 157,078
Soap frame, J. H. Keller 157,203
Soda water cooler, M. S. Andrews 157,088
Spittoon lifter and holder, N. K. Ellsworth 157,165
Stove, base heating, V. Vermilye 157,249
Stove, heating, J. W. Elliot 157,121
Stove, reservoir cooking, J. F. Quimby (r) 6,152
Stoves, oven door for cooking, E. W. Harvey 157,128
Street sweeping machine, R. A. Smith (r) 6,153
Stripping, peeling, and splitting, S. Kuh 157,073
Switch, J. A. Duggan 157,120
Table for undertakers, C. B. Simmons 157,232
Thimble skeins, setting, E. F. Edwards 157,094
Tinner's machine clamp, W. H. Burnett 157,189
Tobacco cutter, S. Rodgers 157,106
Toy, G. W. Hawk 157,095
Toy pistol, S. Tomlinson 157,246
Toy pistol, J. T. Trowbridge 157,109
Trace fastener, R. Whiting 157,111
Umbrella, A. and I. Herzberg 157,176
Umbrella and parasol, W. M. Henderson 157,071
Valve, globe, J. Arthur 157,112
Valve, globe, J. Broughton 157,117
Vehicle wheel, W. Beers 157,060
Vehicle wheel, H. C. Hubbell 157,178
Velocipede, J. F. McClure 157,210
Ventilator, T. W. Bracher 157,148
Vessels, construction of iron, D. W. Zantzinger 157,264
Vessels, propelling, E. Raynale 157,221
Wagon brake, G. Seeger 157,229
Washing machine, I. D. Buck 157,062
Washing machine, A. Cook 157,095
Washing machine, Spangler & Reich 157,137
Watch balance, E. Chapin 157,154
Watch barrel, E. Chapin 157,155
Watch guard attachment, A. S. Potter 157,080
Watch plate, E. Chapin 157,153
Water closet apparatus, A. McGilchrist 157,211
Water wheel, M. E. Washburn 157,250
Water wheel, turbine, C. Healy 157,070
Whip socket, W. W. Richardson (r) 6,148
Windmill, H. J. Wolcott 157,260
Window blind, screen. J. P. Clark, Jr 157,194
Window casing, W. J. Ross 157,224
Wrench, H. D. Rouse 157,082
Wrench ratchet, J. Bowers 157,115

APPLICATIONS FOR EXTENSION.

Applications have been duly filed and are now pending for the extension of the following letters patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

31,443.—FELLY MACHINE.—C. H. Denison. Feb. 3.
31,445.—LIME KILN.—R. Donaldson. Feb. 3.
31,502.—COAL BREAKER.—R. A. Wilder. Feb. 3.
31,533.—WEIGHING APPARATUS.—A. B. Davis. Feb. 10.
31,534.—SCALE BEAM.—A. B. Davis. Feb. 10.
31,566,—DRYING TUNNELS.—F. H. Smith. Feb. 10.
31,579.—CORN PLANTER.—F. B. Preston. Feb. 10.

EXTENSIONS GRANTED.

30,633.—FIRE ESCAPE.—E. B. Larcher.
30,651.—HARVESTER.—S. W. Tyler.
30,685.—SEED DRILL.—H. Moore.
30,691.—CASTING PLOWSHARES.—F. F. Smith.
30,691.—PLOW.—F. F. Smith.
30,719.—PAPER FOLDER.—C. Chambers, Jr.
30,745.—CULTIVATOR.—N. Messenger.

DISCLAIMERS FILED.

102,462.—COOK STOVE.—J. B. Wilkinson, Troy, N. Y.
155,534.—DRESS PROTECTOR.—H. M. Macdonald, Lowell, Ms.

DESIGNS PATENTED.

7,855 to 7,858.—CARPETS.—R. Allan, Yonkers, N. Y.
7,859 to 7,862.—CUTLERY.—J. D. Frary, New Britain, Conn.
7,863.—COOKING STOVE.—G. G. Richmond, Providence, R. I.
7,864.—BOTTLE.—S. C. Upham, Philadelphia, Pa.
7,865 to 7,869.—SILVER WARE.—G. Wilkinson, Pr'dence, R. I.
7,870.—WINDOW SCREEN.—G. Shatswell, Waukegan, Ill.
7,871.—INKSTAND COVER.—H. C. Wilcox, W. Meriden, Ct
7,872.—MONUMENT.—H. C. Borgner, Lebanon, Pa.
7,873.—ORGAN CASE.—G. E. Carhart *et al*, Washington, D. C.
7,874 to 7,876.—CARPETS.—F. W. Green, Orange, N. J.
7,877 to 7, 884.—CARPETS.—H. Horan, East Orange, N. J.
7,885.—PARLOR HEATER.—A. T. Jones, Stamford, Conn.
7,886.—HOT CLOSET RANGE.—A. T. Jones, Stamford, Ct.
7,887.—CARPET.—L. G. Malkin, New York city.
7,888.—WRITING PAPER.—C. D. Myers *et al*., N. Y. city.
7,889.—CARPET.—H. Nordmann, New York city.
7,890 & 7,891.—BUTTONS.—H. E. Bostwick, New Milford, Ct.
7,892 to 7,901.—EMBROIDERY.—E. Crisand, New Haven, Ct.
7,902.—FORK HANDLE.—C. Osborne, N. Attleborough, Ms.
7,903.—STATUETTE.—T. J. Pairpoint, Providence, R. I.
7,904.—OILCLOTH.—C. T. & V. E. Meyer, Bergen, N. J.

TRADE MARKS REGISTERED.

2,072.—CHEWING TOBACCO,—Allan *et al*., Cincinnati, O.
2,073.—STOVE POLISH.—H. A. Bartlett & Co., Phila, Pa.
2,074.—STOVE DRESSING.—B. F. Brown & Co., Boston, Ms.
2,075.—GROCERY.—Harris Bros., New York city.
2,076.—SHIRTINGS.—Naumkeag Steam Co., Salem, Mass.
2,077.—COOK STOVE, ETC.—G. G. Richmond, Pr'dence, R. I.
2,078.—HEALING SALVE.—Stapleton & Co., Springfield, Ms.
2,079.—MEDICINE.—G. Steiff, Cincinnati, O.
2,080.—PERFUMERY, ETC.—J. & E. Atkinson, London, Eng
2,081 & 2,082.—CORSETS.—L. Coleman & Co., Boston, Mass
2,083.—CORSET.—Ottenheimer & Co., New York city.
2,084.—SOAP.—Reed & Co., Pittsburgh, Pa.
2,085 to 2,088.—SALT.—Union Pacific Salt Co., S. F'cisco, Cal.
2,089.—TOBACCO.—Frishmuth & Co., Philadelphia, Pa.
2,090.—PILE REMEDY.—C. Maync, New York city.
2,091.—MEDICINE.—Dr. J. Simms & Son, Wilmington, Del.
2,092.—PICKLES, ETC.—C. G. Summers & Co., Baltimore, Md.
2,093.—SALERATUS.—J. M. Taylor, New York city.
2,094.—SUGAR, ETC.—DeCastro & Donner Co., N. Y. city.
2,095 to 2,097.—WOOLEN GOODS.—Wash. Mills, Lawrence, Ms.
2,098.—GROCERIES.—N. W. Burchell, Washington, D. C.

SCHEDULE OF PATENT FEES.

On each Caveat	**$10**
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ILLUSTRATIONS.

A

Air ship, Rhone's 52
Air, the effects of compressed, Bert's apparatus 18
Aquarium at Southport, England 295
Arrow heads, feathering 5
Axles, machine for turning carriage, Aram's 207

B

Baird, James, Gartsherrie, Scotland 95
Balloon, hot air, Ménier's 377
Balloon, sectional, Hartness' 99
Balloon, Sivel's 55
Barrow in Furness iron shipbuilding works 311
Battery, thermo-electric, Clamond's 84
Bearing, alarm for hot 403
Bear pits at Philadelphia, the 358
Blinder, horse, Kennedy s 275
Blood, the transfusion of 146, 147
Blow-off, surface, Waugh's 310
Bolckow, Mr. H. W. F 175
Boiler covering, Irons and Clayton's 262
Boiler explosion at Dubuque, Iowa 277
Boiler explosion at Geddes, N. Y. 5
Boiler, steam, Harvey's 246
Boiler, vertical, Hill's 98
Bouquet of grasses and flowers, a June 135
Brake, friction 273
Brake, the Westinghouse 20
Brick press, hydraulic, Bodmer's 151
Brick press, Whitehead's 199
Bricks, universal angle, Billings' 291
Bridge over the Mississippi, at Keokuk, Iowa 367
Bridge over the Po, Italy 66
Bridge, railway, near York, Eng 399
Bridge, rolling, at St. Malo, France 67
Bridge, the Comba Scura 351
Bridle, horse, Sanborn's 353
Bullets impacted in the air 5

C

Cannon, the Krupp 10-inch 115
Cap of Liberty, the, Yellowstone region 179
Carrier pigeons 306
Car, section of railroad 213
Castalia, the twin steamer 279
Cattle, Guernsey 247
Centrolinead, Maccord's 274
Clamp, adjustable, Hammer & Co.'s 194
Coal cutter, hand, Jones' 178
Coal screen, Leach's 287
Compass, gravitation, Lord Caithness' 19
Condenser, compound engine, Hathorn's 211
Conservatory at Southport, Eng 295
Conservatory at Sundridge Park, Kent 71
Cooling air, various methods 28
Cow milker, automatic 242
Cranes, safety catch for 377
Crow bar, tamping, Wright and Tew's 98
Cupressus cornuta, cones of the 39
Cutting and punching machine, Reynolds' 102

D

Deer's head, a four-antlered 114
Dicksonia antarctica, the 39
Disintegrator, Davis' 278
Diving bell, Toselli's 19
Docks at Portsmouth, England, the new 354
Dough kneader and cutter, Mockl's 262
Dogs' teeth, filing 72
Dovetailing machine, miter, Davis' 1
Drill, hand crank, New York Engine Co.'s 134

E

Ear trumpet, a simple 36
Encephalartus altensteinii, the 39
Engine and boiler, Hill and Massey's 199
Engine, compound, Davenport's 19
Engine, horizontal compound, Hathorn's 210
Engine, portable, Montel & Co.'s 258
Engine, portable, the Shapley 335
Engine, rotary, Myers' 303
Exposition buildings, Chili 103

F

Face plate, sliding, Whitmore's 357
Fairbairn, Sir William 143
Faucet, improved, Webster's 150
Feed water heater, Fenner's 340
Ferrule and hook for whiffletrees, Starling's 194
Filter, a cheap 251
Fire engine, floating, Merryweather's 388
Fire governor, automatic, Slade's 287
Floor damp, Davidson's 214
Fly catching plant, the 4
Flying machine, proposed 357
Fountain Cave, Va., views in 35
Friction brake, Gill's 340
Furnace, Fairbairn's 194
Furnace for melting brass, Bush's 54
Furnace, safety, Shand and Mason's 50

G

Galls, oak 82
Gardenia, the lemon-scented 359
Gear-cutting attachment, Hopkins' 63
Glass, crystalization of 386
Governor, cut-off, Ord's 86
Governors, pendulum 389, 404
Grain, machine for unloading, Clark's 111
Granary at Bristol, England 79
Grapnel, Toselli's 21
Grappling tools, Dexter's 35
Gun, the new French army 358
Gyroscope, the 91

H

Hammer, air spring, Hotchkiss' 26
Hammer, the monster—The furnace 226

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Hatchet, Wisner's..... 342
Heel trimming machine, Jones'... 230
Hoisting machine, Mason's..... 47
Hot springs, the Mammoth, Yellowstone region..... 179
Hub, Davis'..... 102
Hymenocalyx undulata, the..... 391

I

Ice and freezing house, Newsham & Co.'s..... 255
Ice creeper, Earle's..... 54
Ice-making process, Newsham's.. 54
Independencia, launch of the frigate..... 183
Iris susiana, the..... 82
Iron castings, weak points in..... 227
Ironclad battery, the Stevens..... 87

J

Jack, hydraulic, Biddle's..... 342
Jack, wagon, Rowland's..... 198

L

Lacing belts, McCoy's method.... 357
Laird, John, the late..... 343
Latch, locking, Folsom's..... 150
Lantern, Lordon's..... 198
Lathe, combination, the Strange Company's..... 127
Lifeboats..... 195
Life, geological records of..... 228
Lighter, non-explosive self, Muller's..... 242
Lights for greenhouses..... 275
Lock, Moat's..... 294
Locomotive, double bogie, Mason's 215
Locusts destroying a grain field... 119

M

Market at Florence, Italy..... 83
Mechanical movement, Frese's... 6
Milk can, Gaines'..... 342
Milk cooling can, Fluke's..... 275
Milling machine, the Tanite Co.'s 271
Molding castings, machine for, Eames & Co.'s..... 239
Moss, long..... 263

N

Nail, Lowensohn's..... 403
Needle, Gaillard's..... 22
Normal school, New York city.... 387

O

Orchid, the anæctochilus..... 82

P

Padlock, self-locking, Miller's.... 278
Paint brush, Thompson's..... 86
Palm, the jubæa spectabilis..... 7
Paper burnishing machine, Alauzet's..... 183
Parabola, to draw a..... 213
Parachute, Degroof's..... 291
Pea, plant grown from a mummy. 290
Peat fuel manufacture in Canada. 355
Pekin, the steamship..... 161
Petroleum motor, a..... 41
Phosphoric acid, estimation of, Ville's method..... 388
Photograph frame, enameling..... 242
Photo skylights, French 403
Phylloxera, the grape..... 162
Pinking iron, Welch's..... 342
Pitcher, water, Cox'..... 22
Pittsburgh and its prominent industries..... 376
Planing and molding machine, Furness & Co.'s 406
Planing machine, vertical, Bourne's 163
Plants, curious..... 39
Platinum, melting, Deville's method..... 34
Plows, steam, new..... 243
Potato coverer, Whitford's..... 207
Press, balanced screw revolving, Woolfolk's..... 15
Press, hay and cotton, Mickleson. 38
Printing in boilers, preventing, Johnson's device..... 370
Printing machine, fabric, Bialon's 131
Propeller, measuring a screw..... 240
Propeller of the Britannic..... 56
Pulley, loose, Holden's..... 102
Pulley, taper sleeve, and wheel fastener, Newell's..... 22
Pumpmechanism, Worswick's.... 242
Pump, steam, Valley Machine Co.'s 38

R

Rhodotypus kerrioides, the..... 359
Railroad depot at Bryn Mawr..... 227
Railway, portable, Corbin's..... 130
Ramsden, Sir James, statue of.... 311
Ram, siphon water, Fresc's..... 357
Ram, the hydraulic..... 259
Rebolting machine, Fletcher's.... 127
Rein holder, Smith's..... 358
Rifle contest, international—The targets..... 248
Rudder, Gumpel's..... 195

S

Sash boring and grooving machine, Blaisdell's..... 310
Saws, gang, Arbrey's..... 50
Scorpion, the venomous..... 179
Screw, aerial, De Fonvielle's..... 290
Sczeroch, the..... 228
Sewing machine motor, Young's.. 70
Shafting, lining, Woodward's method..... 388
Shoemaker's combined tool, Ober's..... 242
Singeing cloth, machine for, Bianchi's..... 386
Siphon for drawing liquids..... 228
Siphon for poisons and acids, Weichold's..... 274
Siphon of the Spring Valley Mining Co..... 216
Slide valve, locomotive..... 212
Soap crutching machine, Lehrmann's..... 214
Spanner, hose, Pond's..... 6
Spiders' webs and spinnerets..... 276
Spike extractor, Devine's..... 390
Spray apparatus for throat disease, Fullgraff's..... 168
Stapelia hirsuta minor, the..... 39
Steam generator, the Eclipse..... 31
Steam trap, Bonser's..... 4
Stevens, Edwin A..... 87
Stone sawing machine, diamond, Emerson's..... 159, 163
Stove, cooking, Iredale's..... 38
Stove, open ventilating, Open Stove Ventilating Co.'s..... 198
Stove plate dressing machine, Northampton Emery Co.'s.... 191
Stump sawing machine, Elston's.. 294
Submarine building, Wenmaeker's system..... 306
Sun, measuring the distance of the, Lillard's method..... 180
Surgery, bloodless..... 5

T

Tapping machine, water main, Young's..... 118
Taps, making..... 187
Telegrsph, Morse's conception of the..... 408
Telegraph, the Pacific ocean..... 259
Telegraphy, cable, improvement in, Winter's..... 258
Telescopes, constructing mammoth, Skey's plan for 165
Tempering device, Hawkins'..... 213
Tempering tools, Rose's device for 276
Thermometer, solar, Negretti & Co.'s..... 211
Thermo-motor, Bernardi's..... 150
Thrashing machine, iron framed, Marshall & Co.'s 407
Threader, cutter, etc., pipe and bolt, Empire Manufacturing Co.'s..... 230
Tool, compound, Broadbook's 406
Torpedo, pneumatic, Ericsson's.. 390
Track lifter, railway, Kinzel's.... 191
Transplanter, Coppen's..... 390
Transplanting trees..... 51
Troy, the ruins of—Earthenware jars..... 294
Tunneling, new art of, Haskin's.. 377

U

Underground railway, New York city.—Map of New York..... 307
Underground railway, New York city.—The beam tunnel openings and ventilators..... 338, 339
Underground railway, New York city.—The beams, joints, and couplings..... 339
Underground railway, New York city.—The first bridge..... 307
Underground railway, N. Y. city. The great arch near 96th st .. 402
Underground railway, New York city.—Themasonrytunnelsand ventilating shafts..... 371
Underground railway, New York city.—The profile..... 308
Universal joints in screw shafts .. 340
Urea, instrument for estimating, Russell & West's 258

V

Vacuum, procuring a 75
Vase for flowering bulbs 359
Venus, the transit of 114
Vessels, raising sunken, Sowerbutt's 215
Victoria regia water lily, the..... 263

W

Wagon, dumping, Smith's 118
Water belt for transmitting motion, Robertson's 99
Water wheel, current, McCarty's. 223
Water wheel governor, standard, Snow's..... 182
Water wheel, the Blackstone and Elmer 134
Whitworth, Sir Joseph 383
Wire tramway at Aalsund, Norway, Carrington's 370

Y

Yacht, steam, Khédive of Egypt's 231
Yuccas, a group of 391

MISCELLANY.

Figures preceded by a *star* (*) refer to illustrated articles.

A

Acoustics of public buildings (63) 251
Adulterations, undetectable..... 180
Advertisement, magic of an..... 41
Aerial screw, the*..... 290
Aged, hygienic treatment of the.. 37
Agricultural life in Missouri..... 121
Air, compressed, as a motor..... 85
Air, fresh, value of..... 344
Air machine, ventilating..... 51
Air, motive power by compressed 171
Air pressure and animal life..... * 18
Air pressure in wind instruments 342
Air ship, a novel..... * 52
Air, weight of..... 11
Alarm, hot bearing ..... * 408
Alarm, railway or sea..... 21
Alaska and the Icelanders..... 193
Albumen..... 344
Albumenized paper..... (1) 298
Alcohol 40
Alcohol casks, lining..... (30) 362
Alcohol, effects of..... 91
Alcohol, food, and force..... 224
Alcohol in wine..... 7
Alcohol in wines, estimating..... 245
Alcohol, its relation to physical strength..... 320
Alcohols into nitric ethers..... 40
Alcohol, the strength of ..... (4) 235
Aldehyde ammonia..... (2) 2, 235
Aleutian islands, the..... 259
Alkaline metals and water..... 282
Alloy, a new white..... 321
Alloy for patterns..... 11
Aluminum 91
Amazon, water of the..... 155
American Association for the Advancement of Science. 129, 152, 168
American Institute, the Fair of the..... 193, 233, 244, 248, 296, 344
American Institute Fair, the engines 277
American Institute Fair, the next 83
American inventive genius..... 99
American, the most eminent..... 323
Ammonia for cooling air..... * 23
Ammonia fumes on flowers..... 329
Ammonium chloride, vapor of (37) 315
Ancient race, relics of an..... 341
Ancient weapons, power of..... 177
Anæsthesia by subcutaneous injection..... 324
Anemometer, an 139
Aniline black dyes..... 309
Aniline colors..... 354
Aniline lake, a new material for... 263
Aniline, sausages colored by..... 41
Animals are automata..... 192
Animals as motor powers..... 386
Annatto 149
Annatto for coloring butter.... (3) 314
Annealing boiler tubes..... 171
Answers to correspondents 11, 16, 43, 58, *74, *90, 106, 123, 138, 155, *171, *187, 202, 218, 235, *250, 266, 282, 298, 314, *331, 346, 362, 379, 395, 409
Antiques, the fabrication of..... 112
Antisceptics, natural..... 337
Ant's instinct, the..... 132
Ants, rabies in..... 49
Ants, raiding..... 68
Ants, the..... 113
Ants, the leaf-cutting..... 54
Ants, white..... 20
Apples, American..... 385
Apples, curious..... 324, 357, 388
Apples, keeping..... 293
Apples, preserving..... 71
Apples rot? what makes..... 177
Aquarium and winter garden, Southport, England..... * 295
Aquarium at Manchester, England 24
Aquarium, the..... 80
Archæological explorations..... 83
Architects and builders, hints to.. 209
Arctic exploration, the Austrian.. 184
Arrowheads, beveled..... 169
Arrowheads, feathering..... * 5
Arsenical wall paper..... 81
Arsenic in agricultural and technical products..... 245
Arsenic, Marsh's test for..... (14) 298
Art galleries, illumination of..... 368
Artillery, modern German..... * 115
Asbestos..... (42) 299
Asparagus and celery, medical value of..... 41
Asphalt pavement..... (14) 395
Astronomical notes..... 20, 292, 356
Assyria, explorations in..... 84
Asteroids, the..... (5) 266
Astor library, the..... 3
Asymptote curve, the..... 138
Atmosphere, weight of the..... 91
Atmospheric pressure, changes in 341
Axle grease..... 90

B

Baird, James, of Gartsherrie, Scotland ..... * 95
Ball dropped through the earth 138, 250
Balloon, a new sectional..... 99
Balloon ascent, a novel..... * 55
Balloon, hot air..... *377
Balloon meteorology..... 356
Balloon steering device, a..... *167
Balloons, toy..... (4) 218
Balloon voyage, a..... 68
Balloon, 400 miles in a..... 102
Ball turning..... *293
Bamboo, the..... 162
Barometers, living..... 176
Barometers, use of..... (12) 187
Barrels, straightening gun 107, (26) 187
Barrow in Furness shipbuilding works *311
Barytes green or manganate of baryta 392
Batteries, carbons for..... (19) 362
Battelies, chromic acid for..... 5
Batteries, new galvanic..... 277, *357
Battery, a cheap galvanic..... 209
Battery, galvanic..... 155
Battery power, relative..... (26) 379
Battery, the Leclanché (73) 315, (26) 362
Battery, thermo-electric..... * 34
Battery, the music stool..... 102
Battery, the Smee..... 90
Battery, the Stevens ironclad..... * 87
Beacon lights, American..... 193
Bear pits at Fairmount Park..... *275
Beech blight..... 356
Bechive, politics in the..... 65
Beer, clarifying..... 75
Bees and honey 213
Beeswax, bleaching..... (44) 299
Bell metal..... (31) 363
Bell, Mr. I. Lowthian..... 373
Bells, mending cracked..... 244
Belt lacings 401
Belts, lacing..... *357
Belts, rawhide..... 149
Belts, speed of..... (24) 267
Belt water, for transmitting motion ..... * 99
Bending glass tubes..... 27
Bending timber..... 26
Bending tubes..... 156
Benefactor, a public..... 5
Benzoic acid..... 85
Bessemer, launch of the..... 279
Bessemer saloon, predicted failure of the..... 291
Bicycle, the..... 356
Billion, a..... 138
Birds, educated..... 351
Birds, the flight of..... 216
Black for gun barrels..... (60) 203
Black heads, to remove..... (30) 251
Blacking 139
Blacking, boot..... (45) 283
Blackleading of iron..... 41
Black on German silver..... (63) 283
Black paint for boilers..... (19) 379
Blades, forging sword..... 135
Blades, tempering sword..... 135
Blasting accidents, causes of..... 264
Bleaching ivory and bones..... 49
Blinder, horse..... *358
Blood coloring matter free from iron..... 389
Bloodless surgery..... * 5
Blood, the transfusion of..... *146, 147
Blow-off, surface..... *310
Bluing gun work..... 123
Bluing, washing..... (69) 219
Boat, a tripod..... 231
Boiler covering, new..... *262
Boiler experiments at Sandy Hook 20
Boiler explosion..... 241
Boiler explosion near Geddes, N. Y. * 5
Boiler explosion, remarkable..... *276
Boiler feed, automatic..... 58
Boiler furnace fire clay..... (43) 267
Boiler, improved steam..... *246
Boiler incrustation, zinc for..... 369
Boiler inspection and insurance... 64
Boilers 312
Boilers at the Fair..... 296
Boilers, novel improvements in... 37
Boilers, unequal pressure in..... 123
Boiler, the Eclipse steam..... * 31
Boiler trials, improvised apparatus for..... 257
Boiler, vertical..... * 98
Bolckow, Mr. H. W. F..... *175
Bone black 138
Bone black, artificial..... 291
Bones, a case of fragile..... 226
Bones as manure..... 75
Bones, a woman without..... 176
Boots, cork soled..... *326
Boots, old..... 246
Boots, wet..... 306
Bouquets from field and garden.... *135
Boxer, the South American..... 277
Brain wounds, curious effects of.. 372
Brake, new friction..... *340
Brakes, car..... 343
Brake, the Henderson..... 120
Brake, the hydraulic..... 317
Brake, the Westinghouse..... 22
Brasses, fitting..... *190
Bread, gases from ..... (27) 409
Breathing through the mouth..... 304
Brick press, improved..... *199
Bricks, manufacture of mortar.... *151
Bridge, universal guide..... *291
Bridge and tunnel, St. Louis, open for traffic..... 296
Bridge, a new Niagara..... 131
Bridge, a skew brick..... (44) 251
Bridge at Mezzana-Corti, Italy.... * 66
Bridge at St. Malo, rolling..... * 67
Bridge, Keokuk, Iowa..... *367
Bridge on the Mont Cenis railway *351
Bridge, railway, near York, Eng. * 399
Bridge, the East river..... 9, 289
Bridge, the New York and Brooklyn..... 343
Bridge, the St. Louis..... 69
Bridge, the St. Louis, opening of the 17
Bridge, the St. Louis, testing..... 42
Bridge, the Tay..... 166
Bridle, horse..... *358
Brimstone, black..... (21) 314
Britannia metal, a good..... 262
British Association for the Advancement of Science..... 216, 247
Bryant, William Cullen..... 323
Bromhydric acid..... 337
Bronze ..... (31) 363
Bronze on brass, verde..... (69) 283
Bronze on steel and iron..... (68) 283
Bronze on tin and white metal.... 27
Bronzes of copper and tin..... 294
Bronzing on steel..... (62) 363
Browning bamboo, etc..... (82) 204
Browning gun barrels..... 11
Bude light, the..... 43
Bugs..... 178
Buge, etc., destroying..... 21
Buildings, high..... 120
Bullets impacted in the air..... * 5
Bulls on the track..... 224
Bunions..... (5) 331
Business king, characteristics of a 353
Business outlook, the..... 116
Bust at Rome..... 278
Bust, silver, at Herculaneum..... 275
Butter, coloring ..... (6) 187
Butter, keeping..... 74
Butter, making..... 124
Butter, the detection of suet..... 370
Butter, tin-canned..... 373
Butter, watered..... 342

C

Callipers *133
California's growing industries.. 399
Camera, a field..... 58, (72) 203
Camera glasses..... (18) 298
Camera lucida for drawing..... 296
Camera oscura, an accidental.. (71) 363
Camera, the wonder..... 26
Camphor, powdering..... 117
Canal, a new Russian..... 337
Canal improvements, the Welland. 131
Canals, steam on the..... 68
Canal, the Fort St. Philip..... 4
Candle flames and streaks of cloud 208
Candolles, M. F. de..... 72
Canning fish..... (58) 283
Canning green corn..... 107
Cans, cheap fruit..... 97
Car axle journals..... (15) 250
Car axles, wear of..... 42
Carbon cells and plates..... 392
Carbonic acid as a motor..... 149
Carbon in cast iron and steel..... 135
Carbons, battery..... (20) 187, (55) 203
Carbon, the crystallization of.. 308, 356
Car couplers, draw bars, and buffers 37
Car improvements, patented..33, 99, 120
Car, oscillating railway..... 247
Carpenter's bench, to make a.. (74) 283
Carriage axles, machine for turning *207
Carriage cleaning machine, a..... 121
Carrier pigeons..... 181, *306
Carrots..... 359
Cars, check chains on..... 31
Cars, safety device for railway.... 246
Cars, steam and locomotives..... *212
Cars, street, propelled by springs. 393
Carvacrol 91
Car ventilation..... 52, 165
Case-hardening iron..... (16) 202
Casks, tasteless solution for lining 138
Casting, blowholes in ..... (5) 409
Casting, cleansing..... 139
Castings, sound..... 123
Castor beans in California..... 385
Castor oil..... (4) 187
Catalogue, a specimen..... 7
Catarrh, vapor of ammonia for (16) 262
Cattle, the Guernsey breed of..... *24
Cement for caustic ley tanks..... 37
Cement for glass..... (9) 377
Cement for iron pipes..... 29
Cement for iron vessels..... (11) 409
Cement for millstones..... (45) 251
Cement, hydraulic..... 138
Cement, Sorel's..... (36) 267
Centennial exhibition buildings... *327
Centennial exhibition, the great.. 98
Centennial, Great Britain and the 404
Centennial, prepare for the..... 160
Centennial, the—The work begun. 151
Centrifugal force..... (11) 266
Centrolinead, the protracting*.... 274
Chain towage on the St. Lawrence *322
Chameleons..... 59
Chamois leather, washing..... 91
Charcoal, animal..... (9) 202
Charcoal, bone..... 85
Charcoal, oxydizing power of..... 232
Chasers*..... 21
Chassepot rifle, as altered..... 136
Chemical centennial, the..... 50
Chemistry, the study of..... 342
Chickens, predatory..... 185
Chilian exposition, the..... *103
Chiming machine, new..... 310
China and glass ware..... 182
China making in Dresden..... 119
China, the population of..... 289
Chinese, the, and the sewing machine 207
Chip, an ancient..... 274
Chipping *133
Chloral for headache..... 85
Chloral hydrate..... 54, 91
Chlorates, pulverizing the..... 81
Chloride of copper..... (2) 331
Chloroform dangers..... 305
Chocolate as a beverage..... 341
Cholera and its treatment..... 64
Chord, the length of a, to find.... 139
Chromic acid on textile materials. 257
Cider 293
Cider, preserving..... 11
Cincinnati industrial exposition.. 33
Cistern, building a..... 91
Cistern for soft water..... 43
Cisterns, water in..... 156
Cities, dead..... 81
Citron, preserved..... 155
City, a model..... 247
City built by one man, a..... 128
Clamp, adjustable..... *194
Clamp, improved floor..... *214
Clay in water, suspension of..... 163
Clay, porcelain..... (21) 267
Cloth, saving from rot..... (23) 250
Coal and iron products of the world 369
Coal bricks..... (47) 219
Coal, burning slack..... (29) 379
Coal, damp air on..... 387
Coal cutter, hand..... *178
Coal fields, fire in..... 8
Coal in California, no..... 263
Coal, Pictou..... 307
Coal, price of, and shipbuilding... 241
Coal, structure of..... 159
Cock metal..... (31) 363
Cockroaches, to get rid of..... 43
Cold applic tions to the neck..... 40
Cold weath r, causes of sudden... 341
Colored races, skins of..... (62) 363
Colored rocket stars..... 90, (55) 219
Combustion of charcoal, spontaneous..... 15
Combustion of powder..... 177
Comet, another new..... 104
Cometary retrospect, a..... 32
Comet, Foggia's..... 231
Comets, new theory of..... 117
Comet, spectrum of the..... 20
Comet, the new..... 2, 121
Compass, the gravitation..... *19
Compressed air as a street car motor..... 278
Compressed air machinery..... 209
Concrete ..... (3) 266
Concrete as a building material... 117
Condensor, Körting's..... 39
Connecting rods, fitting..... *164
Conservatory at Sundridge, Eng.. *71
Cooling air, methods of..... *23
Coöperation 344
Coöperation in Great Britain..... 208
Copaiba in croup..... 149
Copper, a preventive of cholera... 149
Copper by precipitation ..... (20) 409
Copper, facts about..... 294
Coppering iron rollers..... 370
Copper plating..... 90
Copyright..... 53
Copyrights for labels, new law.... 17
Corals, ivory, etc., artificial..... 196
Corn meal, analysis of..... (57) 219
Cotton waste, cleansing..... (7) 202
Cotton worm, the..... 168
Cow milker, the automatic..... *242
Cramps in the stomach..... (69) 263
Cranes, safety catch for..... *377
Cranks, turning..... *293
Crater of Maui, the..... 9
Crayfish, the..... (2) 202
Cribbing in horses..... 309, 340
Crime epidemics..... 241
Criminals, the scientific treatment of..... 224, 276
Croton and chloral..... 200
Croup, copaiba in..... 149
Crow and tamping bar..... *98
Crucibles..... 309
Crystallization, water of..... 168
Cupressus cornuta, cones of..... *39
Curculio on peaches, the..... (63) 203
Curiosity, a natural..... 120
Currents, deep sea..... 247
Cutting and punching machine.... *102
Cutting out clothes, machine for.. 233
Cutting speed and feed..... *69
Cyanogen 91
Cylinders, fitting..... *197, *229
Cyprus, explorations in..... 84

D

Daguerreotyping, early days of.... 311
Dam disaster, another..... 70
Dampness in houses..... 155
Days a month long..... 247
Deafening floors..... 123
Death, living..... 216
Death rate, the hourly..... 337
Debt of the United States..... 342
Deer's head, a four-antlered..... * 114
Delivery, what constitutes a mercantile..... 228
Demoniacal possessions..... 273
Dental laboratory, the 245
Dental office furniture..... 245
Dentistry in the United States.... 180, 200, 232, 245
Depot, the Grand Central..... 40
Details, studying..... 97
Diabetes 149
Diamond drill, the..... 391
Diamonds, can we make..... 247
Diamonds, the formation of..... 96
Diamond, the largest..... (11) 331
Diastase as a digestive agent..... 149
Dicksonia antarctica, the..... * 39
Dies, adjustable..... * 101
Dies, hand stock..... 101
Dinner service, the King of Siam's 4
Diphtheria, local remedy in..... 274
Discoverer, an unfortunate..... 24
Discovery, an interesting..... 121
Diseases of the throat and nose.. * 168
Disinfectant, a new..... 180
Disintegrator, improved..... * 278
Dissociation or thermolysis..... 7
Distances, instrument for measuring..... (78) 219
Distances, measuring by sound.... 255
Distilling sea water..... 277
Diving bell, a navigable..... * 19
Dock at Portsmouth, England, new *354
Dock system, New York city..... 8
Dog dentistry..... 7
Dog, filing the teeth of the..... * 72
Dog killing by electricity..... 39
Dog on the witness stand, a..... 361
Doing much..... 245
Dough kneader and cutter..... 262
Draining cellars..... 27
Drains into chimneys, turning.... 401
Drawing as an educator..... 357
Dredging process, a new..... 387
Drill, hand crank..... * 134
Drop press, a large..... 87
Dust, atmospheric..... 39
Dyeing, Epsom salts and sulphurous acid in..... 84
Dyeing feathers..... (39) 299
Dyeing ivory..... (13) 331
Dyeing ivory blue..... 43
Dyeing muslins, calicoes, etc.. (8) 331
Dynamometer, a vehicle..... 7
Dysentery, new remedy for..... 8
Dyspepsia and the use of pepsin... 85
Dyspepsia remedies..... 120

E

Eagle, the bald..... (7) 250
Earth, action of, on o ganic matter 102
Earth, analysis of..... 9
Earth's figure and geologic changes..... 113
Earth, sphericity of the..... (8) 395
Ear trumpet, a simple..... * 36
Eating, economy in..... 272
Ebony, artificial..... 337
Eccentrics, turning..... 261
Eccentric, to find the throw of an ..... (46) 299
Eclipse of April 16, solar..... 15
Education, a good..... 40
Education, practical..... 53
Education, the science of..... 247
Effort, a first..... 84
Eggs, preserving..... (34) 219
Eggs, the decomposition of..... 216
Elbows in pipes, making..... 233
Electrical countries..... 389
Electrical gas lighting..... 111
Electrical machine..... (65) 283
Electrical Society, the American .. 335
Electric amalgam..... 11
Electric condition of flame..... 19
Electric discharges, character of.. 341
Electricity, battery and coil.... (11) 395
Electricity, battery and frictional (2) 187
Electricity by mechanical action.. 31
Electricity, generating positive... 341
Electricity in a boiler..... (3) 362
Electricity, new theory of..... 274
Electricity, toothache cured by... 121
Electricity, vaporizing metals by 120
Electricity, wood-cutting by..... 393
Electric light, cost of..... (22) 379
Electric light, effects of..... 24
Electric railway whistles..... 390
Electro-capillarity, experiment in 17
Electro-chemical paper..... 43
Electro-deposition of metals. 393, 407
Electro-magnetic station indicator 191
Electro-magnets..... 11
Electro-magnets..... (14) 202
Electro-motograph, the..... 145
Electro-motor, the Camacho..... 343
Electro-plating with iron..... (3) 395
Elm trees, dangers of..... 134
Emery paper..... 133
Emery wheels, turning..... 91
Employers, the true course for.... 178
Enamel of the teeth..... 296
Encephalartus altensteinii, the... * 39
Engine and boiler, novel..... * 199
Engineering 2,000 years ago..... 275
Engineers' and pilots' licenses (33) 282
Engineers, convention of civil.... 8
Engineers, education of..... 8
Engineers, schools for..... 329
Engine, horizontal compound *210, 211
Engine, portable..... *258 * 335
Engine question, the small..... 196
Engine, rotary..... 248
Engines and boilers, small..... 113
Engines at the Fair..... 277
Engines, compound..... 386
Engines, compound vs. oscillating 100
Engine, small boat..... 276
Engine, small printing press..... 228
Engines, performance of small.... 148
Engines, portable and stationary.. 4
Engines, reports on small..... * 273
Engines, rotative vs. rotary..... * 112
Engines, small steam..... * 340
Engine, steam, compound ..... * 19
Engines, steam, gain by use of condensers..... 256
Engine, the Myers rotary..... * 303
Engine, three-cylinder..... * 326
Engraving on copper..... 257
Entomological notes..... 356
Ephesus, explorations in..... 83
Equine mechanics..... 22
Erysipelas..... 40
Erysipelas, treatment of..... 84
Etching on glass..... (13) 409
Ether 216
Ether, preparation of..... 54
Etna, eruption of..... 175
Exhibitions, international..... 71
Expansion and contraction..... * 325
Experiments, new feature..... 232
Experiments, two typical..... 384
Explorations in Central America.. 181
Exploring expedition, the Wheeler 290
Explosions, firedamp, produced by sound..... 129
Explosion, spontaneous..... 343
Explosives, recent experiments on 369
Expositions, great..... 153
Eucalyptus globulus, the..... 360
Evaporation instead of ice..... 4
Eye, surgical treatment of the.... 233

F

Face plate, a sliding..... * 357
Fairbairn, Sir William..... * 143
Fair, machinery at the..... 292
Fallacies, popular..... 148
Fall sickness..... 321
Falling bodies, rule for force of... 26
Fare register, street railroad..... 294
Farkin, the ruins of..... 169
Fat in forage plants..... 177
Faucet, improved..... * 150
Fauna of the Middle States, the cave 129
Feed water heaters, gain by using 288
Fence posts..... (58) 347
Fermentation of wine..... (77) 219
Ferns, whitening..... (7) 331
Ferrotype plates..... (44) 219
Ferrule and hook for whiffletrees* 194
Fever nests and their remedy..... 240
Files, classification of..... 11
Files, machine cut..... (80) 220
Files, resharpening..... 361
Filing 133
Filtering, hot..... 41
Filtering water..... * (39) 251
Filtering water for boilers..... (83) 204
Filtration of water..... (3) 235
Fingal cave, the..... 259
Firearms, American..... 387
Fire commissioners of Boston, Mass 321
Fire engine, floating..... * 386
Fire engines, railroad..... 310
Fire engines, self-propelling steam 214
Fire, fighting with explosives..... 15
Fire governor for gas works..... * 287
Fire grates, open..... 224
Fire in Chicago, another..... 64
Fire in cotton mill, Fall River..... 231
Fireless locomotive accident, the 68
Fireless locomotive, explosion of a 5
Fireless locomotive, progress of the 17
Fireless locomotive system, the.... 120
Fire lighter, a..... (42) 347
Fire on the hearth, the..... * 198
Fireproof construction, premium for..... 280
Fire, protection from..... 3
Fires, usual causes of..... 232
Fire underwriters, the board of... 226
Fish bones as fertilizers..... 337
Fish, freezing..... 214
Fishing by means of explosives 118, 184
Fish trade, live..... 354
Flame, jumping of gas..... 144
Flame, recent researches on..... 101
Flame, reflecting power of..... 17
Flies, to kill..... 124
Floods, disastrous..... 97
Flour, danger in bad..... 81
Flower market at Florence, Italy* 83
Flowers, lasting..... (13) 266
Flume, pressure in a..... (24) 379
Fly-catching plant, the..... * 4
Flying machine, a..... *357
Flying, the perils of..... 99
Fly paper..... 75
Fly wheel, bursting of a..... 372
Food adulteration, English..... 97
Forces, the correlation of..... 213
Fork, swallowing a..... 292
Foundery charcoal..... 130
Fossil plant, a..... 343
Fossils of the departed..... 49
Fountain cave, Va., views in.... *33, 36
Fountain, luminous..... (3) 250
Four-footed motion..... * 16
Fox, the late Sir Charles..... 111
Fracture by long continued jarring* 97
Franklin Institute exhibition.. 312, 328
Freights, cheap..... 401
French Association for the Advancement of Science..... 215
French colonies, industrial resources of the..... 144
Friction pulleys..... (18) 409
Frosts, theory of..... 75
Fruit packing room, a..... 58
Fruit trees, cuttings of..... 86
Fuchsin adulterations, detecting 198
Fuel, the economy of powdered... 376
Fulgurites 3
Fulgurites, more..... 274
Fulminate, a new..... 214
Fulminate for cartridges..... (13) 250
Fulminating mercury..... 90
Fulminating silver..... 90
Funeral, will do it after a..... 401
Furnace, a safety..... * 50
Furnace for melting brass..... 54
Furnaces, their construction and management..... * 194
Furs, artificial..... 151

G

Galvanized iron, frosted..... (66) 347
Gardenia, the lemon-scented.....*359
Garden, the indoor..... *359
Gas burner, self-lighting..... 248
Gases, expansion of..... (62) 363
Gases in the coagulation of the blood..... 292
Gas forfuel, natural..... 287
Gas forpuddling, natural..... 37
Gas light, prices of..... 185
Gas mains, sheet iron..... 328
Gas pipes fatal to trees..... 47
Gas refuse, effect on fish..... 323
Gas regulator..... *166
Gas, removing ammonia from..... 341
Gas retorts, improvement in..... 309
Gas saver, the automatic..... *322
Gastric juice, acid in the..... 392
Gas well, a wonderful..... 130
Gas works, fire governor for..... *287
Gear cutting attachment for lathes* 83
Geese and ganders..... 117
Gelatin in coffee..... (70) 363
Gelatin, making..... (9) 187
Gem stones, manufacture of..... 49
Geographical congress, international..... 72
Geological discovery, new..... 115
German silver ..... (24) 409
German silver for casting..... 260
Germ theory of disease, the..... 9
Gift, a valuable..... 326
Gilding ..... (61) 347
Gilding on spelter..... 27
Gilt frames, cleaning..... 27
Glacial action..... 90
Glass, boring holes in..... (16) 218
Glass, crystallization of..... *386
Glass for walls, etc..... 370
Glass, manufacture of plate..... 175
Glass, marking..... (3) 187
Glass, soluble ..... (55) 315
Glass tubes, strength of..... 17
Glass, white opaque..... 211
Glazing for pottery, new..... 113
Gloves, cleaning buckskin..... (66) 363
Glue, marine..... 106, (28) 282
Glue, strong..... 33
Glue, waterproof..... 91
Gluing veneers..... (20) 379
Glycerin, animal..... (9) 202
Gold in New Hampshire..... 378
Gold region, our new..... 149
Gong metal, the Chinese..... 294
Governor, cut-off..... * 86
Grafts, cutting and storing..... 354
Grain elevator, a gigantic..... 149
Grain, unloading, machine for.... *111
Granary at Bristol, England..... * 79
Grapnel, a new..... *214
Grappling tools..... * 6
Grasshoppers, to kill..... 37
Grease on clothes, etc..... (46) 315
Great Eastern, dimensions of the ..... (28) 346
Greenhouses, lights for..... *275
Grinding swords..... 135
Grindstone spindles..... 228
Grindstones, wear of..... 340
Guano, the origin of..... 360
Gulf stream, the ..... (21) 409
Gum arabic mucilage, preserving. 291
Gun, an eighty-ton..... 184, 378
Gun cotton, a slow..... (8) 282
Gun cotton, compressed..... 88
Guns, new Prussian..... 194
Gun, the new French army..... *388
Gymnospe, theory of the..... * 91

H

Hailstones, soda..... 262
Hailstorm, a remarkable..... 49
Hair, gray..... (29) 267
Hair-heading machine..... 248
Hair oil..... (64) 363
Hammer, air spring..... *262
Hammer, a large trip..... 370
Hammer, large, at Woolwich..... *226
Hammers, steam..... 312
Hammer, the common..... 373
Hardening and tempering tools, 68, 84, 100, 116, 132, 148, 165, 180, *213, 276
Hardening a watch spring..... 155
Hardening brass wire..... 155
Hash 216
Hatchet, improved..... *342
Hatching, heat for..... 155
Hawaiians, their physical failure.. 184
Hay fever 85, 215
Hay fever, remedy for..... 66
Hay in Iowa, as fuel..... 193
Head wash..... (65) 363
Health, working men's..... 289
Heat and its relation to construction 114
Heating houses, possible improvement in 336
Heat of the human body..... 342
Heat radiation and colors..... (2) 379
Heat, registering the chemical action of..... 216
Heat, the development of subterranean..... 305
Heel trimming machine..... *230
Herb cultivation..... 183
Hides, carbolic acid for preserving 121
Hilts, dressing the sword..... 136
Hogs of Ohio, extinct..... 152
Hoisting machine..... * 47
Honesty, more machine..... 15
Honey, strained or in the comb... 148
Horse, buying a..... 264
Horse power, nominal..... 107
Horseshoe, detachable..... *326
Horseshoes, india rubber..... *166
Horticulture at the Fair..... 233
Household hints..... 192
Hub, improved..... *102
Huxley, Professor, and Harvard.. 97
Hydraulic jack..... *349
Hydraulic mining..... *216
Hydro-electric cable, the..... 51
Hydrogen by zinc and sulphuric acid ..... (6) 298
Hydrogen gas, making..... 90
Hydrogen generator accidents.... 114
Hydrogen, lifting power of..... 74, 139
Hydrophobia..... 4
Hydrophobia, a cure for..... 200
Hydrophobia, death from..... 15
Hydrophobia—dog's teeth, the.... * 72
Hydrophobia, hot weather..... 3
Hygiene, hospital..... 9
Hygrometer 48
Hymenocalyx undulata, the..... *391
Hypodermic medication..... 82
Hypodermic syringe, substitute for the 149

I

Ice and freezing house..... *255
Ice as a medicine..... 24
Ice cream machine..... 296
Ice creeper..... * 54
Ice houses and spontaneous combustion..... 138
Ice house, to build an..... (29) 251
Ice in New York city..... 41
Ice lenses of unlimited size..... 276
Ice making process..... * 54
Ice, the coldest..... (17) 187
Ignorance and crime..... 116
Immersion lenses..... (8) 409
Incline, tractile power on an..... 139
India rubber, adulteration of..... 17
India rubber in Columbia..... 50
Induction by the Ruhmkorff coil.. 163
Induction coils..... (24) 362
Injections, hypodermic..... 40
Ink, burnishing, for boots..... (57) 347
Ink, Chinese or Indian..... 335
Ink, copperplate..... 11
Ink, invisible..... 280
Ink stains, removing..... 48
Ink, sympathetic..... (56) 219
Ink, white..... 75
Insects, Professor Riley on..... 168

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Insects, preserving ... 138
Insects, replacement of injurious. 152
Inventor, honors to an ... 351
Inventors, a chance for ... 18
Inventors and capitalists, hints to. 304
Inventor, sad fate of an ... 51
Inventors, impracticable ... 256
Iodide of potassium ... 40
Iodide of potassium improved ... 85
Iris, an, and an orchid ... * 82
Iron, American ... 339
Iron and steel, sulphuric acid on .. 322
Iron, case hardening ... 69
Iron castings, cleansing ... 107
Iron castings, weak points in ... 227
Iron, cast—Interesting investigations ... 132
Ironclad, new and powerful ... 244
Iron, coating with copper ... 117
Iron dams ... 117
Iron, English enamel for ... 274
Iron, etching ... 329
Iron, fatty matters in ... 20
Iron for filtering water ... (60) 347
Iron for rinsing bottles ... 153
Iron floating on molten iron ... 133
Iron, galvanizing ... (12) 346
Iron hail ... 127
Iron in a battery ... 379
Iron in Missouri ... 159
Iron industry, the Gartsherrie ... * 95
Iron in stone, fixing ... 391
Iron, modern cast ... 199
Iron, occlusion of gases by ... 360
Iron ore in New York city ... 324
Iron, passage of gas through heated ... 196
Iron pipes, water in ... 388
Iron puddlers' strike ... 298
Iron purifies water ... 149
Iron rail products, our ... 50
Iron rails at Columbus, Ohio ... 329
Iron shipbuilding at Birkenhead .. 343
Iron ships, preservation of ... 70
Iron stains, removing ... (61) 347
Iron, the passivity of ... 278
Iron, weight of cast ... (15) 218
Iron works of the United States .. 322
Iron works, the Degerfors ... 67
Iron with copper, coating ... (3) 202
Island, a floating ... 120
Itch, styrax in ... 233
Ivory, ductile ... (27) 382

J

Java agricultural and industrial exhibition ... 350
Journal boxes, boring ... 75

K

Kaleidoscope, to make a ... 91
Kauri gum ... 257
Kettles, rusty ... 43
Kite navigation ... 200

L

Laboratory at Oxford, the new 388
Labor prospects for the winter 320
Labor, rest, and recreation ... 277
Lake or sea in Africa, new ... 151
Lake, the highest ... 146
Lakes, African, the proposed artificial ... 337
Lampblack, manufacture of ... 132
Landing stage, the Liverpool ... 161
Language of insects and animals .. 80
Lantern, improved ... * 198
Latch, improved locking ... 150
Lathe, fitting a ... 43
Lathe, the combination foot ... 127
Lathe work ... *261, * 325
Latitude and longitude ... 75
Laudanum ... 43
Lawn and pleasure grounds ... 183
Lawyer's advice, a ... 296
Lead, peroxide of ... 155
Lead poisoning ... 197
Leaf and flower impressions ... 165, 214
Leather pulp ... 296
Leguminosæ ... 184
Leg supporter ... 156
Lenses, grinding and polishing (43) 363
Levee, building a ... (2) 266
Levees on the Mississippi ... 20
Level glass, adjusting a ... (25) 218
Leyden jar, to make a ... (16) 218
Leys, utilizing waste ... 181
Libyan desert, exploration of the 96
Liebig, a monument to ... 184
Lick, James ... 5
Lifeboats, on ... * 195
Lifeboats, ship ... * 195
Life, geological records of ... 228
Life-saving invention, a ... 34
Lighthouse, new ... 361
Lighthouses, our ... 388
Lightning and glass casters ... (65) 203
Lightning, are feather beds a protection ... 144
Lightning, magnetism by ... (37) 347
Lightning, oil fired by ... 86
Lightning, protection from ... 144
Lightning rods ... 58, 106, (19) 187
Lightning rods, air in hollow .. (49) 203
Lightning rods and water and gas pipes ... 145
Lightning rods, are more than one useful? ... 145
Lightning rods, how made and applied ... 145
Lightning rods, metal roofs, gutters, etc ... 145
Lightning rods of value, are ... 144
Lightning rods, proper size and material for ... 145
Lightning rods, protective area of 145
Lightning rods, straw ... 321, 324
Lightning rods, terminals of ... 145
Lightning rods, why should they be pointed? ... 145
Light of coming days, the ... 128
Lights of the heavens ... 211
Light, solar, chemical action of ... 198
Lily, the Victoria Regia ... 263
Link motions, fitting ... * 197
Lithographic stone, French ... 387
Lithography ... (1) 298
Lock, improved ... 384
Lockjaw and quinia ... 55
Locomotive, double bogie tank ... * 215
Locomotives and steam cars ... 212
Locomotives, coal burning, in the South ... 244
Locomotives for Russia ... 117
Locomotive, the largest ... 51, 100
Locust in Minnesota, the ... 63
Locusts destroying a grain field .. 119
Locusts, the plague of ... 196
Locust, the seventeen year ... 58
Log, the Hotchkiss marine ... 38
Longitude and latitude ... 74
Louse and the compass, the ... 261
Lovage ... 171
Lunar acceleration ... 309
Lunar acceleration—Its cause ... 260
Lutecine or Paris metal ... 18

M

Machine department at the Fair, 292, 296
Machines, the utility of ... 215
Madder, rose ... (19) 409
Magnetic condensation ... 377
Magnetic experiments ... 228
Magnetic iron columns ... (5) 250
Magnetic metals, the ... 47
Magnetic ore in New Jersey ... 197
Magnetic variation ... (4) 346
Magnetism, a novel experiment in *100
Magnetization, molecular changes of ... 247
Magnetization of steel ... 35
Magnetizing a compass needle (7) 235
Magneto-mechanical separator ... 215
Magnets ... 74, 135
Magnets, how made ... (15) 218
Magnifying glasses ... (9) 395
Manganese in seeds ... 149
Manganese, sesquioxide of ... (29) 410
Mammoth cave of Mexico, the ... 255
Mammoth cave discoveries ... 406
Man, Huxley's theory of ... 224
Manifold writing paper ... (72) 363
Man, pre-glacial, in England ... 274
Map, a novel ... 392
Marking cotton piece goods .. (60) 286
Mary Powell, speed of the ... 195
Masters and men ... 303
Matches ... 43
Matches, phosphorus ... 11
Measuring a tree ... 296
Measuring width of a stream ... 171
Meat preserving process ... 17
Mechanical æsthetics and practical men ... 337
Mechanical engineering and industrial operations ... 208
Mechanical movement, novel ... * 6
Mechanic of the future, the .. 353, 372
Medals, centennial ... 321
Medical notes .. 24, 40, 85, 149, 200, 233
Medicines, mistakes in giving ... 85
Mennonites, the ... 111
Mental conditions, morbid ... 48
Mercury and lead, antidote wanted 24
Mercury, new method of detecting Metachloral ... 150
Metal floating on melted metal ... 342
Metaline ... 233
Metallurgical researches, recent .. 144
Metal ornamentation ... 86
Metals, coloring ... 41
Metals, softening ... 27
Metals, the precious ... 42
Metals, the transmutation of ... 184
Metal surfaces, ornamental ... 81
Meteoric shower, the August ... 136
Meteorological and medical statistics ... 112
Meter, casting the standard ... 34
Metric system, the ... 152
Mica mines in North Carolina ... 385
Microscope as a criminal detective 160
Microscopical ... 38
Mildew in cotton ... 90
Miles and feet, German, Danish, and English ... (24) 346
Milk can, a novel ... *342
Milk cooling can ... 275
Mill, a great flour ... 127
Millingmachine, the Tanite Company's ... 271
Millwrights, school of ... 207
Mind reading ... 291
Minerals, New Jersey ... 244
Mines and minerals of India, the .. 33
Mines, ladders in ... 264
Miniature knitting machine ... 248
Mining, deep ... 391
Mining, the vicissitudes of ... 230
Mississippi, improvement of the .. 257
Mississippi river, the ... 52
Miter dovetailing machine ... * 1
Molding castings, machine for ... 239
Molds for casting resin, etc ... (10) 409
Moles ... 50, 117, (7) 331
Monument at Saratoga ... 24
Moon and the tides, the ... 357
Moon's atmosphere, the ... 75
Morphine, a new alkaloid from ... 51
Mortar for furnace walls ... (48) 219
Mortar, the requisites for good ... 102
Mosquitoes, wash to keep off ... 75
Moss, long ... *263
Motor, a new ... 150
Motor, a petroleum ... 41
Mounds in Iowa ... 40
Mounting maps, etc ... 91
Moxa ... 91
Muscarin ... 177, 341
Museum, a new scientific ... 136
Musical glasses (4) 250, (73) 283, (72) 347
Music by telegraph ... 70
Musicians, primeval ... 81

N

Nail, a new ... *403
Nails and shoe pins ... 51
Nails, brittle finger ... 155
National Academy of Science ... 341
Naval architects, the institution of 324
Navy, machinists in the ... 394
Navy, the German ... 262
Needle, a novel ... 22
Nest egg, to make a ... 53
New books and publications, 9, 24, 72, 88, 121, 136, 153, 169, 200, 248, 280, 329, 361
New Hampshire, physical history of 152
Newspaper conglomerate ... 341
Newspapers in Peru ... 209
New York State Agricultural fair. 98
Nickel mines in Australia ... 180
Nickel muriatic salts of, 50, 293, 330 410
Nickel plates, cast ... 207
Nickel plating ... 43, 90
Nickel plating solutions ... (11) 346
Nickel salts ... (63) 347
Nile exploring expedition ... 81
Nitrate of ammonia for gunpowder ... (12) 266
Nitric acid, neutralizing ... (2) 395
Nitrogen of the soil ... 129
Nitro-glycerin ... 33
Nitrous acid in plants ... 191
Noon mark, making a ... (13) 395
Normal college, the, New York city 387
Notes from Washington, D.C. ... 20, 45, 260

O

Oak apples or galls ... * 82
Oatmeal, cooking ... 360
Oatmeal, manufacture of ... 223
Obituary:
Beaumont, Elié de ... 294
Buckhout, J. C. ... 258
Cornell, Ezra ... 301
Curtis, Benjamin R. ... 229
Fairbairn, Sir W. ... *143
Fisher, S. S. ... 135
Fox, Sir Charles ... 9, 111
Gavit, John E. ... 161
Johnson, T. M. ... 150
Keller, Charles M. ... 277
Laird, John ... *343
Laplace, Marquis de ... 369
Rennie, Sir John ... 233
Saxton, Joseph ... 341
Ocher and umber ... 106
Odorless excavating apparatus ... 175
Odors ... 360
Oil, cheap transit for ... 48
Oil district, the Butler ... 228
Oil, mineral ... 65
Oil, oxygenized ... (26) 409
Oil of birch ... (20) 331
Oils, essential, distilling ... (64) 219
Oils, extracting essential ... 74
Oil spots on paper ... (13) 331
Oil tank cars ... 31
Oil well, a wonderful ... 103
Oleate of soda ... (1) 266
Oleic acid ... (20) 331
Ophir, the ruins of ... 84
Optical delusion, an ... 85
Orchid, an, and an iris ... * 82
Ordnéne experiments, Sandy Hook 378
Organs, making hand ... 55
Osmic acid ... 155
Ostrich, a human ... 351
Otto of roses ... 231
Ower, Samuel, centenary of ... 4
Oxidation shown by color ... 232
Oxygen, discovery of ... 104
Oxygen gas, making ... 90
Oxyhydrogen flame, spectra with the ... 247
Oxyhydrogen light, the ... 324
Oyster culture, American ... 368

P

Padlock, self-locking ... *278
Paint, blistering ... 123
Paint brush ... * 86
Pain in the lower animals, sensation of ... 321
Painting and varnishing trays (67) 203
Painting on albumen paper ... (2) 409
Painting on zinc without paint ... 337
Painting plastered walls ... (20) 346
Paintings, oil, to clean ... (13) 238
Painting weatherboarding ... (12) 409
Palestine, explorations in ... 83
Palm, the jubea spectabilis ... 7
Paper and ink, incombustible ... 6
Papering whitewashed walls .. (10) 331
Paper, palm ... 7
Papers, burnishing colored ... 183
Parabola, to draw a ... * 213
Parachute, M. de Groof's ... 290
Paraffine acid ... 177
Paraffin, some uses of ... 16
Parallel motion ... 26
Parasites ... 153
Parian marble ... (38) 251
Paris metal or lutecine ... 18
Paris, United States commerce with ... 291
Pasigraphy ... 69
Patent decisions of the courts:
Air, carbureting ... 248
Alphabet blocks ... 88
Boiler furnace ... 136
Bracelet ... 88
Clover seed machine ... 408
Corn planter ... 280
Patent decisions of the courts:
Drilling, submarine ... 72
Fire extinguisher ... 104
Fruit jar ... 233
Hair net ... 9
Refrigerator ... 394
Safety valve ... 6
Shawl strap ... 185
Spring, rubber and metal ... 185
Stone breaker ... 216
Time detector ... 72
Tray ... 136
Patent dummy, a ... 39
Patentee, a Chinese ... 373
Patenting imitations ... 309
Patent law, another amendment of the ... 400
Patent Office again, the ... 384
Patent Office, a panic at the ... 272
Patent Office clerks, the ... 401
Patent Office justice ... 65
Patent Office, operations of the ... 352
Patent Office, reform needed at the 389
Patent Office tea set, the ... 404
Patent Office testimonial, the ... 369
Patent Office, the ... 368
Patent Office yearly report ... 369
Patents, Canadian, official list of 12, 28, 41, 60, 76, 92, 108, 124, 140, 157, 172, 188, 204, 220, 236, 252, 268, 284, 300, 316, 332, 348, 364, 380, 396, 410
Patents, English, by American 9, 24, 42, 88, 121, 136, 169, 200, 233 248, 280, 330, 361
Patents in England and United States ... 242
Patents, official list of 12, 27, 44, 59, 75, 92, 108, 121, 140, 156, 172, 188, 204, 220, 236, 252, 267, 284, 300, 315, 332, 348, 364, 380, 395, 410
Patents, recent American and foreign 9, 24, 42, 57, 72, 88, 105, 121, 136, 153, 170, 185, 201, 213, 249, 264, 281, 297, 313, 330, 341, 361, 378, 394, 408
Patents, the Commissionership of 241
Pavement, new concrete ... 136
Peach brandy ... (30) 219
Peach, yellows in the ... 167
Peas three thousand years old ... 290
Peat fuel manufacture in Canada 355, 356
Peat, leaf mold, etc ... 99
Peat paper ... 337
Peculiar people ... 241
Pendulum governors ... *389, 404
Pendulum, length of a ... 27, 156
Pendulum, the cone ... 26
Penholders ... 160
Pennsylvania Railway, the ... 341
Percussion powder for cartridges (59) 315
Peru, engineering in ... 257
Petrifaction vs. putrefaction ... 84
Petroleum barrels, cleansing ... 124
Petroleum benzin for oleoresins .. 41
Petroleum, boiling point of (17) ... 266
Petroleum products ... 58
Pharmaceutical conference, British 50
Phelps, Dodge & Co., case of ... 24
Phosphate of lime ... (12) 331
Phosphor bronze axle bearings ... 152
Phosphor bronzes, new ... 329
Phosphorescence, insect ... 231
Phosphorescence of animal matter 231
Phosphoretted hydrogen ... 232
Phosphoric acid, etc., estimation of ... 388
Phosphorus and phosphates in purification ... 223
Phosphorus bronze ... 65
Phosphorus light, the ... (66) 203
Photographing lace on silk ... 391
Photographs, enameled and embossed ... * 242
Photographs, immense ... 402
Photographs, waxing ... (29) 362
Photograph, the glace or enameled 359
Photography on tin ... (1) 298
Photo-lithography ... (12) 202
Photo skylight and tent ... *403
Phylloxera, chemical effect of the 369
Phylloxera, the ... 231, 273
Phylloxera, the eucalyptus and the 292
Phylloxera, the grape ... * 198
Pickets in a fence ... (7) 409
Pickles ... 155
Picture frames, composition for .. 228
Piles in salt water, preserving ... 124
Pinking iron ... * 342
Pip among chickens ... 155
Pipe and bolt threader and cutter* 230
Pipe cutting and threading machine 296
Pipes and plates, non-corrosive ... 290
Pipes, protecting cast iron ... 255
Piston rings ... 293, 325
Pistons and rods, turning ... 293
Pitcher, water ... * 22
Pittsburgh and her industries ... * 376
Pittsburgh manufacturers for 1873 153
Pittsburgh, the subterranean fires 369
Plane irons, grinding ... 324
Planer, surface, the Hamilton ... * 319
Planetary motions, the relations of 84
Planetary orbits, relations of ... 17
Planing and molding machine ... 405
Planing machine, vertical ... 163
Plaster bandage, a new ... 287
Plate, cleaning and burnishing (13) 298
Plating with platinum ... 106
Platinum, furnace for melting ... * 34
Plows, new steam ... * 243
Plumbers' carelessness ... 176
Plumber's defence, the ... 292
Pneumatic burial ... 209
Poisoning by shot ... 85
Poke root, the ... (48) 299
Polar expedition, the latest ... 401
Polish, French ... 11
Polishing shirts ... (77) 203
Polishing swords ... 135
Population of the United States 152, 263
Postal cards, incendiary ... 723
Postal system, the ... 224
Post Office, the New York ... 50
Potassic sulphocyanate ... (34) 219
Potassium, a lecture experiment with ... 5
Potato, a new ... 329
Potato bugs, vesicatory 213, 231, 277, 356
Potato bug, the ... 309
Potato bug, the Colorado ... 52
Potato coverer, improved ... 207
Power for cotton machinery ... 48
Power for turning wheels ... (14) 409
Power in cotton mills ... 165
Power in cotton mills, waste of .. 320
Power of a water wheel ... (9) 409
Power-supplying company, a ... 1
Practical man, the ... 80
Practical mechanic at the Fair ... 244
Practical mechanism ... 196
Practical mechanism 21*, 69*, 101*, 133*, 165*, 197*, 229*, 261*, 293*, 325*, 373,* 405*
Practical men and mechanical æsthetics ... 337
Precious metals, the ... 232
Premium for carriage lamp ... 18
Prescription, a queer looking .. *51, *84
Press, balanced screw cotton ... 15
Press, hay and cotton ... 38
Pressure of water in casks ... (1) 409
Pressure on piston ... (4) 409
Pressures, experiments at high ... 216
Priestley centenary, the ... 104
Priestley centennial, the ... 50
Priming, device for preventing .. * 370
Printers' roller composition .. (56) 283
Printing ink ... (19) 298
Printing machine, fabric ... * 131
Printing, polychrome ... 368
Printing press improvements, recent ... 32
Printing without a press ... 199
Prismatic colors, proportions of the 75
Prison reform ... 336
Prizes for essays ... 325
Prizes for essays on steel ... 376
Prizes for hand turning ... 168
Propeller of the Britannic ... * 56
Propeller shafts, lining ... 107
Propellers, screw ... 86
Prurigo and pruritus ... 200
Pulley, loose ... * 102
Pulley, taper sleeve, and wheel fastening ... * 22
Pump difficulty, a ... (28) 409
Pumping engine, automatic ... 296
Pump mechanism, improved ... * 242
Pumps, improved steam ... * 38
Pumps, test of ... (8) 250
Pump, the Sprengel ... 95
Putty, colored ... 107
Putty, removing old ... 392
Pyrometers ... 216

Q

Quick as wink ... 177
Quicksilver in California ... 3
Quicksilver mines in California ... 130

R

Rail, fast travel by ... 42
Railroad depot at Bryn Mawr, Pa. * 227
Railroad employees and their pay 256
Railroads, consumption of wood by 287
Railroads, early opinion of ... 337
Railroad train, fast ... 207
Railroad train timer ... 169
Railroad, wooden, in Michigan ... 358
Rails, the manufacture of ... 8
Rail system, the one ... 370
Railway, an 18 inch ... 242
Railway, a portable ... * 190
Railway cars, French ... 117
Railway, 440 miles by ... 65
Railway gage, change of ... 72
Railway rails, rusting of ... 352
Railway regulations, Pennsylvania 378
Railway Review, the Chicago ... 72
Railway rolling stock, U. S ... 120
Railways and wheeled vehicles 264, 279
Railways, English and American 98, 215
Railways, German ... 128
Railway signals, the block system of 216
Railways in New York city ... 100
Railways of the United States ... 16
Railway station, the Holborn viaduct ... 130
Railway statistics ... 180
Railway track lifter ... * 191
Railway trains, coal per mile ... 305
Railway traveling, rapid ... 392
Railway up Mount Vesuvius ... 71
Rain at New Haven, Conn ... 135
Rainbow, a lunar ... 72
Rain gage, to make a ... (5) 235
Rains, queer ... 198
Raisins, making ... (17) 409
Ramsden, Sir James ... * 311
Ram, the hydraulic ... * 259
Rapid transit in New York 229, *259, 304
Rarefied air, breathing ... 290
Rat science vs. alligator strength .. 134
Rat, the California wood ... 68
Rattan ... 127
Reason why, the ... 103
Reboiling machine ... * 127
Reflection, extraordinary ... 216
Reforestation in Japan, the ... 151
Refrigerating car, railway ... 290
Refrigerating mixtures and their physiological effects ... 17
Refrigerating process, new ... 88
Regatta, the annual college ... 65
Reinholder, improved ... * 358
Reservoir, fall of a ... 230
Reversion of thoroughbred animals 152
Rheumatism, guarana in chronic .. 149
Rhodium, metallic, new property of 120
Rhodotypus kerriodes ... * 359
Rib, laying out a curved ... 171
Rickets and softening of the bones 200
Rifle barrels, straightening ... (68) 251
Rifle contest, the international .. * 248
Rifle sights at Creedmoor ... (70) 283
Rock, crystaline, decay of ... 341
Rock drill, a compound engine ... 113
Rocks, the disintegration of ... 152
Roman remains ... 351
Rome, explorations in ... 83
Root beer ... 138
Rope, testing ... 185
Rose, the qualities of the ... 37
Rosin oil ... (18) 266
Rowers, the training of ... 37
Rubber insulators, substitutes for 344
Rubber, solvents for ... 368
Rubber stamps ... 156
Rubber thermometers, hard ... 372
Rudder, improved ... * 195
Rule, draftsman's ... * 274
Russian international exposition .. 184
Rust, cleaning off ... 107
Rust on iron and steel ... (32) 299
Rust on steel tools ... (59) 283

S

Safety valves, formulæ for ... 107
Sail, the shadow ... 52
Sal ammoniac, inhaling ... 200
Salt as manure ... 178
Salt raising bread ... (16) 379
Salts in food ... 263
Sal, a curious property in ... 337
Sand, sonorous ... 149
Sandstone to marble, transformation of ... 277
Sandwheel, to make a ... 26
Sar cephagus, an Italian ... 1, 21
Sargasso sea, the ... 91
Sash boring and grooving machine *310
Saw contest at Cincinnati ... 296
Saw improvements, gang ... * 50
Sawing lumber ... (44) 347
Saw making, French ... 194
Saw premium at Cincinnati, the .. 260
Saw, premium for circular ... 168
Saw, scroll ... 248
Saws, speed of ... (20) 202
Saws, speed of teeth of ... (5) 218
Saw, the diamond band ... 296
Saxton, Joseph and his labors ... 341
Scabbards, making sword ... 136
Science and metallurgy ... 3
Science as a tree ... 134
Science, recent advances in ... 29
Science, the National Academy of 341
Scientific American in Germany, the ... 262
Scientific American, special edition ... 288, 353
Scientific American, to subscribers ... 405
Scientific American, value of the ... 37, 168, 280
Scientific and practical information ... 9, 17, 37, 49, 81, 113, 131, 149, 177, 257, 289, 321, 337, 360, 369
Scientific industry, society for the promotion of ... 263
Scientific marketing ... 149
Scientific investigation, aid to ... 16
Scient, the ... 264
Scorpions and their venom ... *178
Scotland, exploratio n in ... 8, 4
Sce en coal ... *287
Screw cutting tools ... *21
Screw propeller, measuring a ... *240
Screw shafts, universal joints in .. *340
Scribing block, the ... *133
Sczarcoh an American invention, the ... *228
Sczaroch, the ... 70, 260
Sea sickness and vomiting ... 85
Sea weeds ... 22
Sighter, non-explosive ... *242
Sensitized paper ... 74, 120
Sensitizing gelatin ... 91
Sensitizing gelatin paper ... 82
Sensitizing paper ... (64) 203
Sewage, machine for drying ... 131
Sewage question, the ... 168
Sewage, utilization of ... 2, 7
Sewing machine motor ... *70
Shad, American, in Germany ... 193
Shad shipped to Persia ... 161
Shaft and cranks, water works ... 54
Shafting, how to line ... *388
Ship, a new double ... 7
Ship, capsizing a ... (16) 409
Ship launch, disaster at a ... *183
Shipping of the world ... 403
Ships, non-inflammable ... 81
Ship, the polyspheric ... 100
Shoemaker's combination tool ... *242
Shrinkage in hardening ... 139
Shrubbery, the ... *359
Silk rags, utilization of ... 309
Silvered telescopic mirrors ... 177
Silvering glass ... (20) 267
Silvering glass, Draper's method of ... (31) 267
Silvering glass, Siemens' process ... (19) 331
Silvering mirrors ... (18) 203
Silver ore from Connecticut ... 293
Silver plating ... (15) 187, (23) 362
Silver plating fluid ... (35) 299
Singeing cloth, machine for ... *386
Siphon, a great ... *216
Siphon for drawing liquids ... *228
Siphon for poisons and acids ... *274
Siphon water ram, a ... *357
Sirius ... 31
Sirup, making starch ... (27) 379
Six-legged rivals, our ... 113
Size, printer's gold ... 74
Skeletonizing leaves ... 155
Skin diseases, Gurjun oil in ... 7
Slide valve, the ... *373
Slide valve, improved ... *166
Slide valves, pressure on ... (46) 299
Slide valves, proportioning ... (46) 299
Slugs, rose, to destroy ... 207
Smalt ... 155
Soap crutching machine ... *214
Soap, erasive ... 181
Soap, hard, with tallow ... (4) 331
Soap, soft and hard ... (10) 379
Soap water on incandescent metals 244
Soda water law suit, a ... 373
Sodium press ... 232
Soils and fertilizers ... 99
Solar heat, differences in ... 129
Solder for brass ... (55) 363
Soldering tin ... 43
Solder in thin bars ... (76) 283
Sound and moisture ... (10) 395
Sounding the Pacific ... 179
Sound, philosophers on ... 3
Sounds, the simultaneous perception of ... *80
Sound, the transmission of ... 36
Spanner, patent ... *6
Specific heat ... 132
Spectroscope, a direct vision ... 168
Spectroscope, new ... 261
Spectroscopic art in England and America ... 392
Spermaceti, purifying ... (36) 251
Spider, ingenuity of a ... 392
Spiders' webs and spinnerets ... *276
Spike extractor, improved ... *390
Spiral theory of physical phenomena, the ... 36
Spiritualism, how to investigate .. 381
Spiritual phenomena ... 126
Sponge divers, the Syrian ... 60
Spontaneous combustion ... 159
Spontaneous combustion in hay ... 310
Spring, horse power of a ... (81) 223
Spring, winding a tapered ... (57) 203
Square, the ... 134
Squirrel's leap, a ... 133
Stains of fruit, to remove ... (48) 289
Stapelia hirsuta minor, the ... *33
Star catastrophe, a ... (44) 205
Starch, potato ... (39) 315
Stars, numbers of the fixed ... 152
Stay, can we ... 160
Steam and pressure ... (16) 395
Steamboat, new French river ... 121
Steam cars ... 116
Steam, cutting wheat by ... 383
Steam engines, gain by condensers to ... 256
Steamer Castalia, the English channel ... *279
Steamer City of Pekin, trial trip .. *161
Steamer, new ... 291
Steamer, fast Atlantic ... (21) 331
Steamer, the Bessemer saloon ... 56
Steamer, the Tokio ... 360
Steam for heating purposes, exhaust ... 336
Steam generator, the Eclipse ... *31
Steaming, fast ... 153
Steam navigation, early history of 198
Steam trap ... *4
Steel chrome ... 181
Steel direct from the ore ... 323
Steel, French improvements in ... 8
Steel, hardening ... (41) 347
Steel manufacturers, to American 280
Steel, restoring burnt ... 6, 180
Steel, softening ... 123
Steel, tool ... 21
Steel, what is ... 352
Steel, Whitworth ... 22, 100
Stevens Institute of Technology .. 360
Stevens, Messrs., and their ironclads ... *87
Stings, remedy for insect ... 118
St. Joseph exposition, the ... 169
Stone sawing machine, diamond .. *159
Stones, cutting ... 59
Storms, facts about ... 79
Stove, an open ... *198
Stove, a novel cooking ... *38
Stove plate dressing machine, American ... 191
Stove polish ... (55) 219
Strasbourg goose culture ... 81
Stucco, improved ... 333
Stump sawing machine ... *391
Stumps of trees, rotting ... (72) 219
Subscribers, to our present and future ... 369
Stuttering ... 275
Submarine building ... *306
Success and blunders ... 121
Success, ways to ... 199
Suction ... 352
Sudorific, a new ... 370
Sugar making, improvements in .. 151
Sulphate of copper optics ... 309
Sulphur, a mine of liquid ... 294
Sulphur, etherole of ... 85
Sulphuric acid on lead ... 289
Sulphur in Iceland ... 149
Sulphur in lead poisoning ... 81
Sulphur in Sicily, and its reduction from the ore ... 295
Sumac ... (68) 363
Sun, measuring the distance of the *180
Sun, motion of in space ... (75) 203
Sun's apparent diameter, changes in the ... 290
Sun's declination, the ... (7) 395
Sun, photosphere of the ... 404
Sun, spectrum analysis of the ... 90
Sunstroke, quick remedy for ... 131
Sun, the constitution of the ... 393, 404
Sun, the temperature of the ... 339
Sun, velocity of the ... (13) 314
Superstition, mediæval ... 343
Surgical freezing ... 242
Swatra, the ... 191
Swelling of cattle ... 58
Swim? can you ... 96
Swimming with the clothes on ... 180
Switch accident, a ... 48
Sword grips, making ... 136
Sword manufacture in Birmingham ... 135
Sydney exhibition, New South Wales ... 337

T

Tallow, bleaching ... 27
Tan on the face and hands ... 139
Tape worm, kousso for ... 233
Tapping machine, water main ... * 118
Tapping screw threads ... (14) 298
Taps and dies ... 101
Taps, forming and tempering ... 340
Taps, making ... *(1) 187
Taps, V-threaded ... 228
Tar roofing ... (13) 347
Taxing power of the legislature ... 52
Tea exports, Indian ... 245
Tea, Indian and Chinese ... 247
Teeth, chemical and galvanic action on ... (1) 117
Teeth, composition filling for .. (1) 202
Teeth from vulcanite, removing .. 361
Teeth, manufacture of artificial .. 181
Teeth, mounting of artificial ... 200
Teeth of children, removing ... 17
Teeth, value of the ... 100
Telegraph between Great Britain and Ireland ... 278
Telegraph cable, Brazilian ... 378
Telegraph, conception of the ... *403
Telegraphic cables ... 306
Telegraphic crows ... 69
Telegraphing, quick ... 275
Telegraph lines, government monopoly of the ... 400
Telegraph paper, chemical (37) 299, (65) 347
Telegraph posts, trees for ... 153
Telegraph relay, new ... 376
Telegraphs in Mexico ... 72
Telegraphs, open circuit ... (5) 395
Telegraph survey, Pacific Ocean .. 191
Telegraph, the Brazilian ... 136
Telegraph, the builder of the first 103
Telegraph, the Pacific ocean ... * 259
Telegraph wire, four messages on one ... 56
Telegraph wires ... 184
Telegraph wires, kite tails and ... 113
Telegraphy, American ... 121
Telegraphy, an improvement in cable ... * 258
Telegraphy, cable ... 292, 324, 372
Telegraphy, cheap ... 406
Telegraphy in the United States .. 294
Telegraphy, new discovery in—The electro-motograph ... 145
Telegraphy, pneumatic ... 180
Telescopes, constructing mammoth 165
Telescopic lenses, improved ... 216
Telescopes, reflector ... (6) 409
Temperature kills? what ... 289, 356
Temperatures, underground ... 7
Tempering anvils ... (67) 219
Tempering cast steel ... (82) 2
Tempering steel for cutting burrs, etc ... (8) 202
Teredo, the ... *
Terrapin, breeding ... 214
Testing chlorides ... 58
Testing colors for their fastness .. 146
Testing governors ... (52) 362
Testing oak and pine ... 263
Testing oxide of zinc ... (39) 267
Testing urine ... 81
Tests for oils ... 326
Thermometer, mean of a ... (25) 346
Thermometer, separation of mercury in a ... (53) 299
Thermometer, solar radiation ... * 211
Thermometers, rubber ... 341
Thrashing machine, iron framed .. *407
Thunderstorm, the safest place in 144
Tides in the Gulf of Mexico ... 95
Tides of lakes and lakelets ... 212
Tiles, cementing ... (29) 202
Timber, the growth of ... 36
Time by telegraph ... 152
Tin, corrosion of ... 9
Tin, crystalization of ... 304
Tin cup, scale on a ... (17) 331
Tinfoil ... (69) 203
Tinning gray iron ... (14) 362
Tin, precipitated ... 139
Tin waste, the utilization of ... 319
Tobacco, analysis of ... (19) 250
Tobacco and the brain ... 138
Tool, compound, new ... *406
Tools, forging ... 21
Tools, hardening ... 21
Tools, machine, at the Fair ... 296
Tools, metal working ... 248
Tools, scraping ... * 164
Torpedoes, effects of ... 113
Torpedoes, range of ... 257
Torpedo practice at Newport ... 144
Torpedo, the Ericsson pneumatic* 390
Trades' unions, decline of ... 406
Transferring engravings to glass (4) 298
Transplanter, improved ... * 390
Trees for avenues ... 181
Trees in hot weather ... 37
Trees, transplanting ... * 51
Trepanning, cocoanut ... 49
Trotting, fast ... 136
Troy, explorations in ... 83
Troy, jars found in the ruins of . * 291
Tunnel, a new Thames ... 56
Tunnels, cost of ... 288
Tunnels, ventilation of railway ... 169
Tunnel, the French and English .. 321
Tunnel, the St. Gothard ... 196
Tunnel, the St. Louis ... 72
Tunnel under the Hudson river .. * 376
Turnings, tyre ... (23) 202
Tyndall, Prof. and the Buddhist .. 308
Tyndall's address at Belfast, Prof. 208
Tyndall's address, Professor ... 176, 192
Tyndall on typhoid ... 385
Tyres, contraction of ... 42

U

Underground railway in Constantinople ... 290
Underground railways in London . 261
Underground railways, the, N. Y. city .307, *323, 338, 339, *371, 387*402
Undulation, velocity of primary .. 129
Unionidæ, the North American ... 129
United States, machinery in the ... 85
Urea, instrument for estimating .. *358
Uric acid, effects of ... 24
Urine, new compound from ... 392

V

Vacuum in a bottle ... * 75
Valve for gases and corrosive liquids ... 100
Valves, setting locomotive ... 124
Vanilla from pine trees ... 37
Vanilline ... 342
Van, the lake and city of ... 184
Vapors and the solar rays ... 177
Varnish, paraffin ... 91
Varnish, waterproof ... 11
Vase for flowering bulbs ... *359
Vegetation, more curious ... 39
Vehicles, wheeled, and railways .264, 279
Ventilation and cooling air ... * 23
Ventilation, simple plan of ... 324
Venus, transit of .53, *114, 155, (52) 283, 400
Vertebrates, power of thought in. 247
Vessels, apparatus for raising ... *215
Vibrations of solids optically studied, the ... *153
Vigorite ... 351
Vinegar from molasses ... 75
Violin notes, softening ... 49
Violin tones, softening ... 123
Vise work ... *164
Vise work—Pening ... 197
Vise work—Tools ... *135
Vivisection ... 192
Volcanoes and earthquakes ... 247
Volatilization of metals ... (26) 314

W

Wagon, dumping ... *118
Wagon jack, improved ... *198
Walking feats, recent ... 350
Wall paper, red, dangers of ... 343
Washington, D. C., notes from 20, 148, 260
Waste in manufactures, prevention of ... 116
Watch key, refitting a ... 129
Water impurities, rain ... 54
Water in cisterns ... 156
Water in galvanized pipes ... (13) 202
Water in lead pipes ... (11) 302
Water in the spheroidal state. (31) 219
Water, maximum density of ... 232
Water power sewing machine (15) 409
Water pipes, lime in ... 81
Waterproof glue ... (80) 204
Waterproofing cloth ... 74, (42) 347
Waterproofing compound ... 290
Waterproofing linen ... 118
Waterproof paper ... 146
Waterproof paper ... (23) 409
Waterproof silk paper ... 39
Water, purifying ... 155
Water, sanitary condition of ... 51
Waterroughs, size of ... (3) 409
Water, weight of ... 156
Water wheel, current ... *223
Water wheel governor ... *182
Water wheel, the Blackstone and Elmer ... *134
Wave motion ... 356
Weapons, the results of improved 50
Webster, Daniel, statue to ... 185
Welding, the philosophy of ... 118
Wells, foul ... 36
Well water, microscopic examination ... 41
Wheel question, the ... (5) 298
White metal ... 139, (51) 363
White not a color ... (5) 379
Whitworth industrial scholarships, the ... *388
Wiredrawn steam, loss from ... 107
Wire tramways ... *370
Wind, pressure and velocity of ... 123
Wind, printing the direction of the 152
Wood a costly building material .. 183
Wood, dyeing black ... (18) 282

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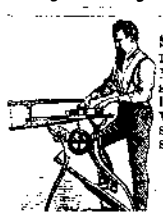

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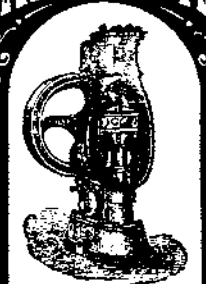

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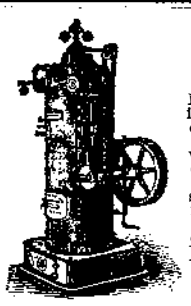

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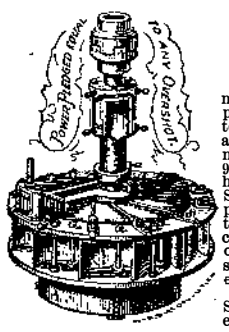

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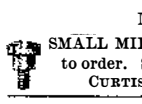

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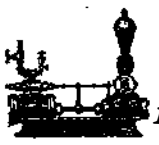

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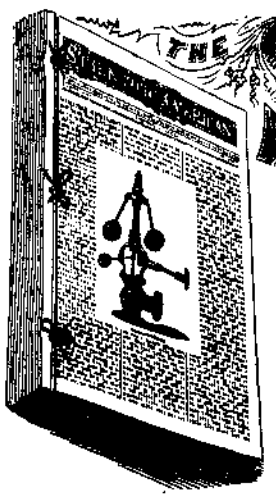

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